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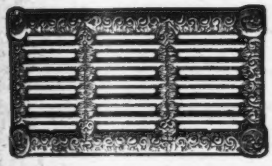

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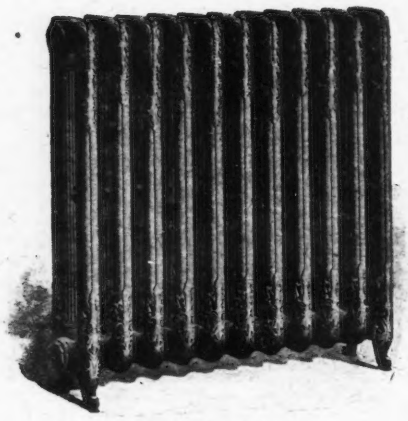

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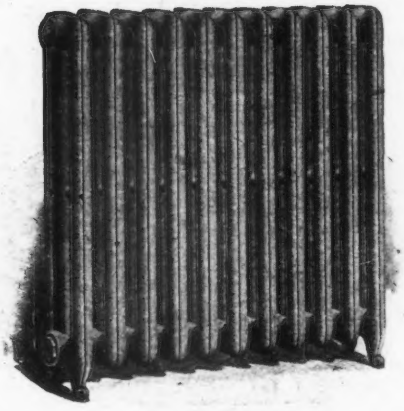

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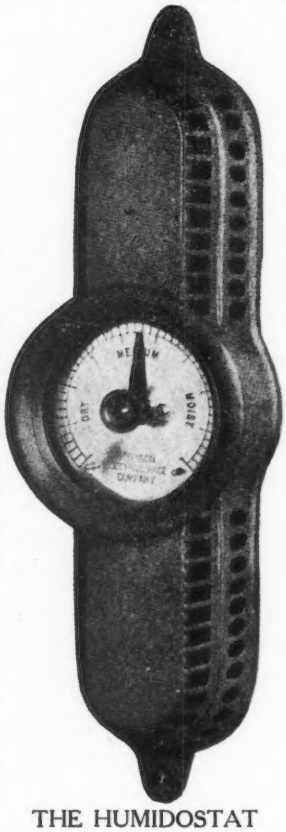

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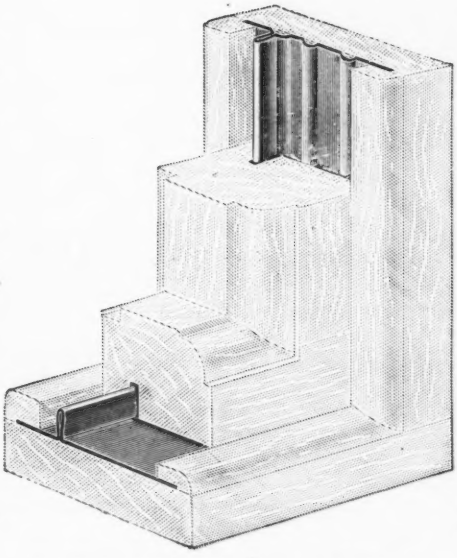

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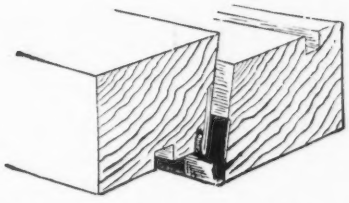

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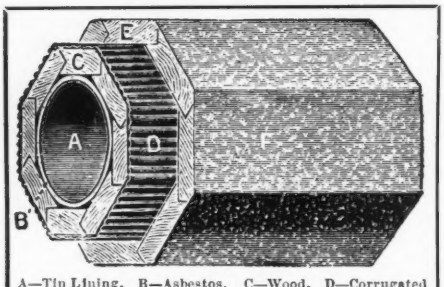

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The same pipe covered with wood and solid earth lost 11.2 per cent.

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The Heating and Ventilating Magazine

VOL. V No. 10

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SEE SWEET'S INDEX

THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK OCTOBER, 1908

Some Facts and a Few Theories Concerning the Operation of a Central Station Hot Water Heating and Electrical Generating Plant

BY PROF. J. D. HOFFMAN

PROF. J. D. HOFFMAN

The Plant

GENERAL DEVELOPMENT.—There has been considerable discussion concerning the economic results to be obtained by combining district heating systems and district electrical generating systems; consequently a description of a successful plant, with some facts relating to its operation, may be of special value to your readers.

The data given in Table I, upon which this article is based, are used with the consent of the Merchants' Heating and Lighting Company, of Lafayette, Ind., and were obtained from two tests of the plant, one made in 1908 and one in 1906. Both tests were conducted by senior mechanical students of Purdue University, at the suggestion of the company. These data are in general verified by observations from a third test upon the plant in 1904, the data of which it was thought not necessary to add.

The system, hot water with forced circulation by pumps, was installed as a part of the Merchants' lighting plant in 1902 by Mr. W. H. Schott, of Chicago, and has been in continuous service, excepting in the warm summer months when residence heat is not desired.

Fig. 1 shows the layout of the plant at the time of the tests. This, in the important points, is about as it was originally designed and installed. Extensive improvements, however, looking toward increased capacity and economy, are now in progress. In designing the plant the capacity was assumed to not exceed 100,000 sq. ft. of radiation. At the time of the test in 1904 the plant was carrying only 70,000 sq. ft.; in 1906 this had been increased to 118,000 sq. ft., and in 1908 to 150,000 sq. ft. This increased capacity above that originally planned for was made possible in the power plant by increasing the capacity of the boilers and the pumping units and by increasing the temperature of the circulating water; in the conduit it was found that on cold days it was necessary to resort to forcing. This latter observation may have been the cause which led to the remodeling of the main system this past summer. There is little doubt that the high steam consumption shown by the pumps in the 1908 test is partially due to excessive friction from high velocities in the principal main near the plant.

The capacity of the electrical plant was also greatly increased. This increase in the electrical plant was due not so much to a natural growth, such as would be expected in any city, but to a reduced price of output made possible by the utilization of all waste in the combined systems; a feature not easily obtained when running the heat-

ing and power systems separately. Since this article will deal almost exclusively with the heating system, the description of the electrical part of the plant will be slighted.

The success of the combined systems up to this time is admitted by all interested parties. The patrons of the company have been well satisfied and, at the same time, the books of the company show a safe and satisfactory balance.

Methods of Heating the Water

Referring to Fig. 1, the return main delivers the water directly to the circulating pumps. From the pumps the water is forced through the exhaust steam heater and thence through the heating boilers to the supply main in the system, or it may by-pass the exhaust steam heater to the heating boilers, or, after leaving the exhaust steam heater, it may by-pass the heating boilers to the supply main. All exhaust steam from the plant, after passing through oil separators, is led to the exhaust heater. The heat from the exhaust steam, except in very mild weather, is not enough to supply the system, and it becomes necessary to provide additional heat from some other source; in this case, heating boilers.

A 1,000 sq. ft. vertical tube Baragwanath condenser is used to condense the exhaust steam. With the present steam consumption of the entire plant it was found that the capacity of this condenser should be increased. There is now being installed a co-mingler which will serve as a siphon condenser and carry the exhaust condensation at once into the circulating system. This should relieve the congested condition on the condenser.

For the direct heating, water tube boilers are used, the water entering from a header below the boilers at the rear and leading from the top of the boilers to a header and thence to the flow main. In such an arrangement the flow of the water through the boilers is assisted by the natural upward circulation from the heat of the tubes.

TABLE I—PARTIAL SUMMARY OF RESULTS

		1906	1908
1.	Square feet of radiation	118,000	150,000
2.	Temperature of circulating water in degrees F., flow main	158.36	164.4
3.	Temperature of circulating water in degrees F., return main	139.9	139.6
4.	Temperature of circulating water in degrees F., after leaving Heater	145.6	147.
5.	Temperature of outside air in degrees F	32.6	37.5
6.	Temperature of stack gases in degrees F., steaming boiler		566.8
7.	Temperature of stack gases in degrees F., heating boiler	562.	656.
8.	Draft in stacks (all boilers averaged) in inches of water	.689	.595
9.	Heating value of coal in B. T. U. per pound	12800.	11565.
10.	B. T. U. delivered to steaming boiler per hour by coal	18,187,000	25,833,000
11.	B. T. U. delivered to heating boilers per hour by coal	19,226,000	27,917,000
12.	B. T. U. delivered to circulating water by heating boilers per hour	11,800,000	15,405,000
13.	B. T. U. to be charged to heating boilers (Item 12—Item 15)	7,650,000	6,934,000
14.	B. T. U. delivered to circulating water by exhaust steam from the generating engines per hour	3,600,000	6,602,000
15.	B. T. U. thrown away during test from pump exhausts and available for heating circulating water	4,150,000	8,471,000
16.	B. T. U. available for heating circulating water from all exhaust steam as in normal running (Item 14 + Item 15)	7,750,000	15,073,000
17.	Total B. T. U. given to circulating water per hour (Item 13 + Item 16)	15,400,000	22,007,000
18.	Gallons of water pumped per hour [Item 17 ÷ (8.33 × Items 2 — 3)]	100,000	108,000
19.	Gallons of water pumped per square foot of radiation per hour (Item 18 ÷ Item 1)	.85	.70
20.	Efficiency of heating boilers (Item 12 ÷ Item 11) approx.	.60	.55
21.	Value of the coal in cents per ton of 2,000 pounds at the plant	200.	175.
22.	Average electrical horse power	68	111

Note.—In Table 1 average values were taken for each entire test and the B. T. U. values were considered satisfactory when approximated to the nearest thousand.

One boiler is used exclusively for heating, one exclusively for steaming, and the rest so connected and valved that they may be used either for heating or for steaming. This makes a very flexible system, in that nearly every piece of apparatus may be considered an independent unit and may be thrown in or out of the circuit, to suit the requirements of that part of the system.

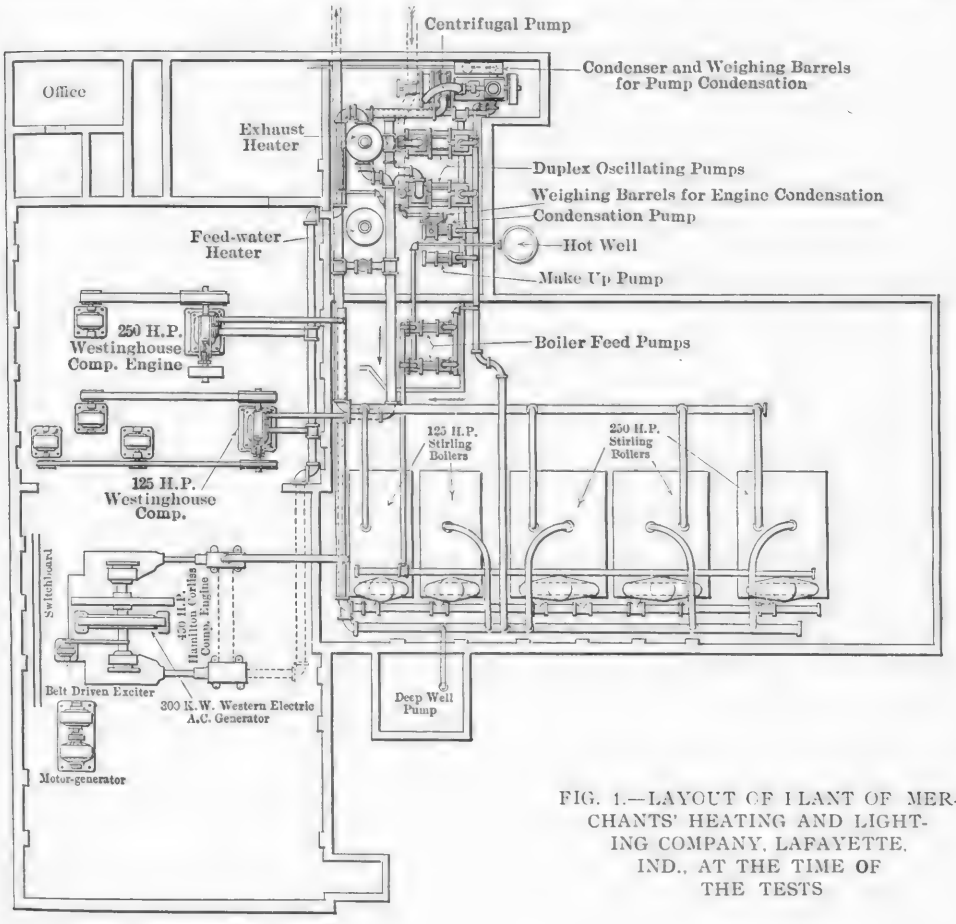


FIG. 1.—LAYOUT OF PLANT OF MERCHANTS' HEATING AND LIGHTING COMPANY, LAFAYETTE, IND., AT THE TIME OF THE TESTS

Equipment of the Plant

The plant has the following important pieces of apparatus employed in generating or absorbing the heat supply:

BOILERS (steaming and heating).

Two 125 H.P. Stirling. Total heating surface 2524 sq. ft.

Three 250 H.P. Stirling. Total heating surface 7572 sq. ft.

Pressure on steaming boilers (gage), 150 lbs.

Pressure on heating boilers (approx.) 60 lbs.

ENGINES.

One 450 H.P. Hamilton Corliss compound, direct connected to a 300 K.W. Western Electric 72-pole alternating current generator 120 R.P.M. This engine carries the load of the plant when it is above 50 K.W. This is generally from 5.30 A.M. to 11.30 P.M. When this unit is run, direct current is obtained by passing the alternating current through a motor generator set.

One 125 H.P. Westinghouse compound, belted to one 75 K.W. 3 phase alternating and two direct current generators and run at 312 R.P.M. This unit is generally run between 11.30 P.M. and 5.30 A.M.

One 250 H.P. Westinghouse compound belt connected to a 200 K.W. generator and two smaller machines.

PUMPS.

One centrifugal two-stage, Dayton Hydraulic Company, direct connected to a Bates vertical high speed engine at 300 R.P.M.

Two Smith-Vaile horizontal duplex re-

ciprocating 14 in. x 12 in. x 18 in. Each of the three pumps connects to the return main in such a way as to be able to use any combination at any one time to circulate the water. The centrifugal pump has been in service only one season. It has a capacity about equal to the two reciprocating pumps and under the heaviest service this pump and one of the duplex pumps are run in parallel.

One Smith-Vaile horizontal reciprocating tank pump 6 in. x 4 in. x 6 in. to lift the water of condensation from the exhaust heater to the tank.

One Smith-Vaile horizontal reciprocating make-up pump 6 in. x 4 in. x 6 in. to replace the water that is lost from the system.

Two National horizontal reciprocating boiler feed pumps.

One 9½ in. Westinghouse air pump, to keep up the supply of air through the conduits to the regulator system in the heated buildings.

One Deane vertical deep well pump, to deliver fresh water to the supply tank.

One Baragwanath exhaust steam heater or condenser, having 1,000 sq. ft. of heating surface.

Preparations for Conducting the Test

The only changes in the plant for conducting the tests, other than installing thermometers, calorimeters and indicators, were the connecting up of the two sets of weighing barrels, as shown in Fig. 1, to catch the water of condensation from the electrical generating units and from the pumps. The condensations from these general divisions were kept separate and the units within them so bunched at different periods of the tests as to enable a fair estimate for each efficiency.

Ordinarily the exhaust steam from the entire plant goes to the condenser and is available for heating the circulating water. During the tests, however, it was necessary to lead the pump exhausts to a separate condenser, and this contained heat was not available to the heating system. In the economic results that follow, this heat is assumed to be saved. All the circulating water went through the heater first and then through the heating boilers. Temperatures were taken at each point, giving means of obtaining the heat absorption within the heater and the heating boilers. It will be noted from the above that the conditions were not ideal, in that the shortage of exhaust steam placed a correspondingly heavier load upon the heating boilers. This, it seemed, could not be avoided.

Cost of Heating Radiation for the Average Year as Found by the Tests

The following estimates will be made upon three bases:

A.—Assuming all the heating to be done by heating boilers.

B.—Assuming the heat from the exhaust steam from the electrical plant to be a credit to the heating system.

C.—Assuming both, the exhaust steam from the electrical plant and that from the pumps, to be a credit to the heating system.

The average temperature of the outside air for the seven cold months (5,040 hours), October to April, inclusive, as given by the U. S. Experiment Station at the University for a period covering about 20 years, is 38° F. All results of the tests, therefore, are reduced to this figure.

A—Heating Boilers Only.—The cost of heating the entire system for the average year will be

$$\frac{\text{Item 17} \times 5040 \times \text{Item 5} \times \text{Item 21}}{\text{Item 9} \times \text{Item 20} \times 2000 \times 38}$$

This will equal: For 1906, $8,670; for 1908, $15,057. One square foot per average year is: For 1906, 7.35c.; for 1908, 10c.

B—Electrical Exhaust Steam Credited.—Substitute in the formula under A (Item 17 — Item 14) for (Item 17) and we find the cost of heating the entire system for the average year to be: For 1906, $6,676; for 1908, $10,540. One square foot per average year is: For 1906, 5.6c.; for 1908, 7c.

C—All Exhausts Credited.—Substitute in the formula under A (Item 17 — Item 16) for (Item 17) and we find the cost of heating the entire system for the average year to be: For 1906, $4,306; for 1908, $4,700. Also one square foot per average year is: For 1906, 3.65c.; for 1908, 3.12c.

The above figures take account of the cost of the coal only, and do not

allow for labor, supplies, or the wear and tear of the machinery in the plant.

To compare with the above figures a theoretical case may be considered. One square foot of hot water radiation, under average conditions of service, will give off 1.7 B. T. U. per degree difference of temperature per hour. The average temperatures of the water in the radiators in the above tests were approximately 149° and 152° F., respectively. (Item 2 — Item 3) ÷ 2 + Item 3. Assuming all inside temperatures to be 70° F., the transmission of heat per square foot of radiation per hour was 134.3 and 139.4 B. T. U. For the average heating year this would be (134.3 × 5040 × 32.6) ÷ 38 = 580,700 and (139.4 × 5040 × 37.5) ÷ 38 = 693,500 B. T. U. transmitted per square foot of radiator surface.

At the power plant, with a conduit loss of, say, 15%, these would be increased to 683,177 and 815,882 B. T. U. With furnace efficiencies as found under the tests, the loss at the coal pile would be 683,177 ÷ .60 = 1,138,628 and 815,882 ÷ .55 = 1,483,422 B. T. U., or 89 lbs. and 128 lbs. of coal per square foot of radiation per year. With coal at the rate of 200c. and 175c. per ton, this would theoretically cost the producer 8.9c. and 11.2c., respectively, to heat one square foot of radiation for the year, assuming no exhaust steam to be used.

Comparing these figures with the results of the tests, the theoretical results seem to be a little high, as shown by the ratios 7.35 : 8.9 and 10 : 11.2.

The efficiency of the heating boilers in the second test was 5% lower than in the first test. This may be partially accounted for by the fact that they were being forced to supply the large amount of radiation due to the pump exhausts being turned into a separate condenser and not being available for heating purposes.

The temperature of the stack gases, as tabulated, would seem to verify this statement. Under normal conditions of running, we might be justified in expecting 60% efficiency in these boilers. If this were true, the cost of heating in the second test and in the calculations relating to it would reduce to 9.1 and 10.26c., respectively.

Referring again to the test data, it will be seen that all the exhaust steam supplied in the first case 50% and, in the second case, 68% of the total radiation; the exhaust steam from the generating engines alone supplying 23% and 30%, respectively. The exhaust steam from the pumps cannot be called a by-product except as it is a necessity in the movement of the circulating water. None of this heat is wasted, and, in this way, it becomes an economy; however, it should be the desire to reduce the quantity of steam from the pump exhausts to as low a point as possible and increase the exhausts from the generating engines by increasing the electrical output.

Effect of Increasing the Radiation, With Electrical Output the Same as In the Second Test

This increased demand upon the heat supply could be handled by the same amount of water at a higher temperature or by a greater amount of water at the same temperature. In this case, let us assume the latter conditions and also assume that the conduit pipes are large enough to carry circulating water for an increased radiation of, say, 25%; a total of 187,500 sq. ft. With boiler efficiency, value of the coal, temperatures of the water in the conduit pipes, and all other conditions as in the second test, the total heat lost per hour from the system on the day of the test would be 27,508,750 B. T. U. This value will be substituted for Item 17, 1908 test, in the formulas as worked out in A, and we will solve for A′, B′ and C′ conditions. It will be noted that the pump exhausts under the proposed increase will approximate 12,000,000 B. T. U. per hour, judging from the rate of increase of 1908 over that of 1906. This has no foundation in fact, and is only assumed for the sake of argument. In any case, it will affect only Case C, which is not so important as either Cases A or B.

A′—Heating Boilers Only.—Cost of heating the entire system for the average year, $18,820; and one square foot for the average year, 10c.

TABLE II

	Cost of total radiation for average year in dollars	Cost of one square foot for average year in cents
Test of 1906, 118,000 sq. ft. A	8,670.00	7.35
Test of 1906, 118,000 sq. ft. B	6,676.00	5.60
Test of 1906, 118,000 sq. ft. C	4,306.00	3.65
Test of 1908, 150,000 sq. ft. A	15,057.00	10.00
Test of 1908, 150,000 sq. ft. B	10,540.00	7.00
Test of 1908, 150,000 sq. ft. C	4,700.00	3.12
Theoretical case, 1906, A		8.90
Theoretical case, 1908, A		11.20
Radiation, 187,500 sq. ft. Exhaust constant. 1908. Condition A′	18,820.00	10.00
Radiation, 187,500 sq. ft. Exhaust constant. 1908. Condition B′	14,300.00	7.62
Radiation, 187,500 sq. ft. Exhaust constant. 1908. Condition C′	6,092.00	3.25
Radiation, 150,000 sq. ft. Exhaust increased 25%, 1908. Condition A″	15,057.00	10.00
Radiation, 150,000 sq. ft. Exhaust increased 25%, 1908. Condition B″	9,408.00	6.27
Radiation, 150,000 sq. ft. Exhaust increased 25%, 1908. Condition C″	3,614.00	2.41

B′—Electrical Exhaust Steam Credited.—Cost of heating entire system for average year, $14,300; and one square foot for the average year, 7.63c.

C′—All Exhausts Credited.—Cost of heating entire system for average year, $6,092; and one square foot for the average year, 3.25c.

Effect of Increasing the Electrical Output, with the Radiation the Same as in the Second Test

Assuming again the same conditions as in the second test, excepting the 25% increase in the electrical output, and solving as in A, for A″, B″ and C″ we have:

A″—Heating Boilers Only.—Same as in A.

B″—Electrical Exhaust Steam Credited.—Substitute (Item 17 — 1.25 × Item 14) for (Item 17) and we find the cost of heating the entire system for the average year to be $9,408; and one square foot per average year, 6.27c.

C″—All Exhausts Credited.—Substitute (Item 17 — Item 15 — 1.25 × Item 14) for (Item 17) and we find the cost of heating the entire system for the average year to be $3,614; and one square foot per average year, 2.41c.

Compiling the above values, we have the figures shown in Table II.

There will probably be no better basis from which to estimate the efficiency of the heating plant than from Case B, since the exhaust from the circulating pumps should not be counted as a by-product. The smaller pumps, such as boiler feeds and the like, would, of course, be considered as a part of the electrical generating plant.

The effect of increasing the electrical output rather than the radiation is shown in the last column B, 1908, B′ and B″; B″ being 10% less than B, and B′ being 9% greater.

ANNOUNCEMENT

As this month marks the opening of another heating season we will resume in the November issue the publication of the full weather data in our weather charts, including the temperature fluctuations, direction and velocity of the wind and the relative humidity variations. As to the latter, this magazine is now negotiating with the Government Weather Bureau with a view to securing the use in the local weather bureaus of automatic humidity recorders, which are not now included in the government equipment.

Temperatures for Testing Direct Radiation Systems*

By W. W. Macon

The accompanying tables are designed to cover steam and hot water direct radiation. They are designed to allow the heating contractor to circulate the water at some convenient temperature in the case of hot water, or to operate at some convenient pressure in the case of steam. The indoor temperature that he should realize will be given in the table according to the temperature of water or the pressure of steam at which the system is designed to operate in the severe weather.

In other words, if the direct radiation plant is installed to operate in zero weather and maintain 70° indoors when steam is at 3 lbs. pressure, instead of running the plant at 3 lbs. pressure during the test when it may be, for example, 15° outdoors, the steam plant may be operated at 2 lbs. pressure, and the table will show the lowest temperature which the rooms should have if the plant is to be satisfactory at zero weather.

EXAMPLE FOR STEAM HEATING SYSTEM

For example, suppose that a direct steam radiating plant has been installed under a guarantee to warm the building to 70° when it is zero outside, with the steam at 5 lbs. pressure. Rather than waiting until it is zero the contractor makes a test when it is 22° out of doors and circulates steam at 3 lbs. pressure. The table is used to determine what the indoor temperature should be if the system can be counted on to meet the specification.

It will be noted that each vertical column of Table I gives figures for the pressure which it is expected to operate during zero weather. The horizontal lines correspond to the pressure at the time of the test. It will be noted in the vertical column marked 5 lbs. that opposite the 3 lbs. pressure of the test a temperature of 68.3° is to be expected when it is zero outdoors. But the test is made at 22°, not when it is zero. At the bottom of each vertical column is given a factor which is the number of degrees additional which must be realized in the indoor temperature for every degree that the outside temperature is above zero. As the temperature at the time of the test was 22° above zero we must add to 68.3°, 22 times 0.692, or 15.2°, making a total of 83.5°, the temperature which should exist indoors.

EXAMPLE FOR HOT WATER HEATING SYSTEM

Similarly an example may be worked out for a hot water system. Suppose that a test is made when it is 10° outdoors of a system designed to operate in zero weather with water at 180°. Suppose the water is at 170° at the time of the test. Opposite 170 in the left-hand column of the table for a hot water heating system and under the column headed 180 is found the figure 66.1. The factor, or the number of degrees which must be added to the 66.1 for every degree that the outside air is above zero is 0.611. For 10° it is 6.1, which, added to 66.1, gives a temperature indoors of 72.2°.

THE BASIS OF THE FIGURES

These tables are based on the following assumptions: The amount of heat given up by the radiation installed in the building is equal to the number of square feet of radiation multiplied by the number of heat units given off for each square foot of radiation per hour—that is, the heat given off by the entire amount of radiation is equal to $R \times h \times (T - t)$, which means that the total radiation is multiplied by the coefficient of heat transmission per square foot per degree of difference, and this product multiplied by the number of degrees difference between the me-

*Topical Discussion at the Recent Summer Meeting of the American Society of Heating and Ventilating Engineers.

dium within the radiator and the air outside of it.

The amount of heat supplied by the radiators goes toward offsetting the amount of heat lost by the building, including that chargeable to accidental ventilation. This may be expressed as equal to the product of the equivalent glass surface of the exposed walls, the heat given off per square foot of glass per degree difference between indoor and outdoor temperature, and the number of degrees difference—that is, the heat lost by the building, including that lost by ventilation, is equal to EGS $\times$ u X $(t' - t)$, in which u is equal to the number of heat units lost per hour per square foot of the EGS of the exposed wall for every degree between the temperature indoors and that outdoors.

As the heat given off by the radiators is equal to that lost through the exposed walls and through leakage ventilation, the two expressions are equal, and it will be seen that the total amount of radiation multiplied by the co-efficient of heat transmission from the radiation is to the product of the EGS and the corresponding co-efficient of glass transmission as the difference in temperature indoors and outdoors is to the difference between the temperature of the medium in the radiator and the room temperature. That is

$$\frac{R \times h}{EGS \times u} = \frac{t' - t}{T - t'}$$

As the radiation is in place and is expected to give off the same amount of heat per degree no matter what the temperature in the radiator or in the room is, and as the EGS of the building remains, of course, constant, and the amount of heat transmitted per square foot per hour per degree is also a constant factor, the ratio of heat given up by the radiation for 1° difference to that transmitted by the wall per degree difference is a constant quantity. This means that the difference in temperature between the indoor and outdoor temperature has always a definite relation to the difference in temperature between the medium in the radiator and the indoor temperature.

If the proper amount of radiation has been installed in a buildng to operate, say with steam at atmospheric pressure when it is zero outdoors, maintaining 70° indoors, the ratio of temperature differences is $(70 - 0) \div (212 - 70) = 0.49$. This figure must, according to the assumptions, always give the value of the ratio between the temperature differences stated.

In other words, if this same system were tested at 10° outdoors, and with steam at 1 lb. pressure, that is, at 215°, the indoor temperature would have to be a definite figure in order that the ratio of the temperature differences should be 0.49. The accompanying tables have been worked up on this basis which should be correct unless outside wall surface

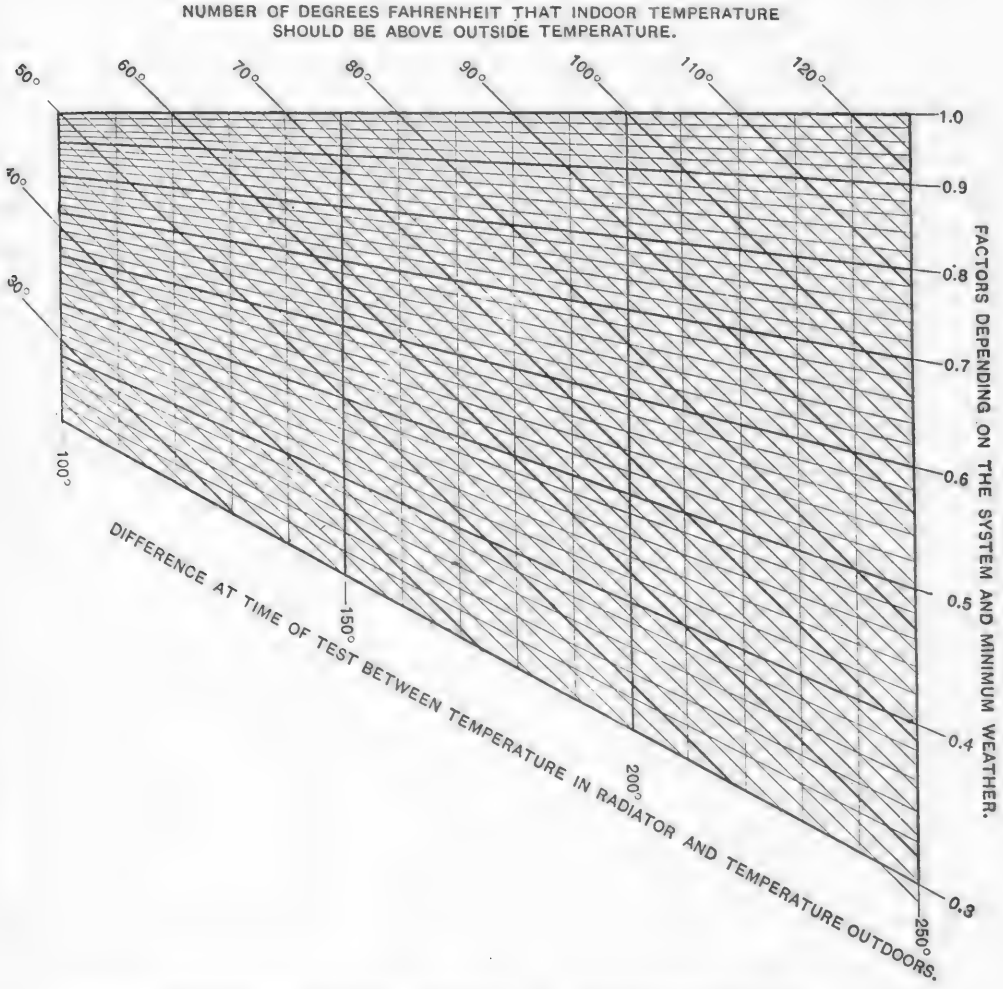
TABLE 1.—TEMPERATURES FOR TESTING DIRECT STEAM RADIATION PLANTS.

Gauge pressure, pounds per square inch. / Inches of vacuum.	Test condition.	Steam temperature in degrees F.	Steam pressure intended for zero weather. 0	1 lb.	2 lb.	3 lb.	4 lb.	5 lb.	6 lb.	7 lb.	8 lb.	9 lb.	10 lb.
10 in.		192	63.3	62.3	....	....	....	....	....	....	....	....	....
9 in.		194.5	64.2	63.2	62.3	....	....	....	....	....	....	....	....
8 in.		197	65	64	63	62.2	....	....	....	....	....	....	....
7 in.		199	65.6	64.7	63.7	62.8	62	....	....	....	....	....	....
6 in.		201	66.3	65.3	64.3	63.4	62.6	62	....	....	....	....	....
5 in.		203	67	66	65	64	63.3	62.6	61.9	....	....	....	....
4 in.		205	67.6	66.6	65.6	64.7	63.9	63.2	62.5	61.7	....	....	....
3 in.		207	68.3	67.2	66.2	65.3	64.5	63.8	63.1	62.3	61.7	....	....
2 in.		208.5	68.8	67.7	66.7	65.7	65	64.2	63.6	62.8	62	61.5	....
1 in.		210.5	69.4	68.3	67.5	66.4	65.6	64.8	64.2	63.3	62.6	62.1	61.5
0 lb.		212	70	68.8	67.8	66.9	66.1	65.3	64.6	63.8	63.1	62.6	62
1 lb.		215.5	71.2	70	69	68	67.2	66.3	65.8	65	64.2	63.7	63
2 lb.		218.7	72.1	71	70	69.2	68.2	67.3	66.7	65.9	65.1	64.5	64
3 lb.		221.7	....	72	71	70	69.2	68.3	67.6	66.7	66	65.4	64.8
4 lb.		224.5	....	....	71.8	70.8	70	69.2	68.4	67.5	66.7	66.2	65.7
5 lb.		227.2	....	....	....	71.7	70.8	70	69.2	68.3	67.6	67	66.3
6 lb.		229.8	....	....	....	....	71.7	70.8	70	69.2	68.4	67.7	67.2
7 lb.		232.4	....	....	....	....	....	71.7	70.9	70	69.2	68.6	68
8 lb.		234.9	....	....	....	....	....	....	71.7	70.8	70	69.3	68.7
9 lb.		237.3	....	....	....	....	....	....	....	71.5	70.5	70	69.3
10 lb.		239.4	....	....	....	....	....	....	....	....	71.3	70.7	70
	Factors		0.67	0.675	0.678	0.684	0.688	0.692	0.694	0.698	0.702	0.705	0.707

will not transmit heat in direct proportion to the difference between indoor and outdoor temperature. It is possible that with the high winds that prevail at outdoor temperatures of 20°, say, almost as much heat is lost through leakage of air through the building walls as when the temperature outdoors is zero and there is little or no wind.

GETTING TEMPERATURE BY MEANS OF DIAGRAM

As supplementing the tables may be given the accompanying chart suggested recently by Capt. Emile Mathieu, instructor at the Military School of Belgium (published in *L'Hygiene du Batiment,* for July). This is more comprehensive even than the tables, for it allows one to



Factor for direct steam at atmospheric pressure and 70° indoors when zero outside = 0.49.
Factor for direct steam at 5 lbs. pressure and 70° indoors when zero outside = 0.46.
Factor for hot water at 190° mean temperature and 70° indoors when zero outside = 0.636.

CHART FOR TESTING DIRECT RADIATION HEATING SYSTEMS

Start at diagonal corresponding to the specifications. Follow this diagonal until it intersects with the diagonal giving the difference in temperature between the interior of the radiator and outside temperature at time of test. A line drawn horizontally from this point of intersection will give the temperature above that of the outside air which should be obtained in the room.

TABLE II.—TEMPERATURES FOR TESTING DIRECT HOT WATER RADIATION PLANTS.

Temp. at test in degrees F.	Water temperature intended for zero weather in degrees F.							
	150	160	170	180	190	200	210	220
150	70	65.7	61.8	58.3	....	....	....	....
160	74.7	70	65.9	62.2	59	....	....	....
170	....	74.4	70	66.1	62.7	59.5	....	....
180	....	....	74.2	70	66.3	63	60	....
190	....	....	....	73.8	70	66.5	63.3	60.4
200	....	....	....	....	73.7	70	66.7	63.6
210	....	....	....	....	....	73.5	70	66.8
220	....	....	....	....	....	....	73.3	70
Factors	0.532	0.561	0.588	0.611	0.63	0.648	0.666	0.682

ascertain the proper indoor temperature for plants designed to heat at other minimum temperatures than zero, and any desired temperature indoors. The tables on the other hand, are based on warming the interior to 70° when the temperature outdoors is zero, and for other specifications other tables would be necessary.

The way to use the accompanying chart is as follows: It will be noted that it consists of two sets of diagonal lines and one set of horizontal lines. The diagonal lines pitching from the right to the left correspond to the ratio of temperature differences. (The minimum outside temperature under which the system is to operate is subtracted from the indoor temperature that is desired. This difference is divided by the difference between the temperature which the steam or hot water is to have and the indoor temperature.) The other set of diagonal lines pitching from the left to the right corresponds with the difference between the temperature in the radiators at the time of the test and the outside temperature at the time of the test. The horizontal lines gives the number of degrees above outside temperature that the room should be at the time of the test.

Suppose the steam plant is to warm a building to 70° when it is minus 10° outside. With steam at 5 lbs. pressure, the ratio of temperature difference is equal to $70 - (-10 \div (227 - 70) = 0.51$, 227° being the temperature of steam at 5 lbs. pressure. Suppose at the time of the test the steam pressure is 4 lbs. or at a temperature of 224.5°, and that the outside temperature is 10° above zero. The difference between the steam temperature and the outdoor temperature is 214.5°. We therefore trace along a diagonal line corresponding to 0.51 and note where it intersects the diagonal line corresponding to 214.5. When reading horizontally from the point of intersection of the diagonals, it is noted that the temperature is 72°. This, as stated, represents the number of degrees between indoor and outdoor temperatures at the time of the test, and as this is 10° the temperature of the room should be 82°.

*Types of Natural Ventilation Systems**

By Reginald G. Kirkby

I recently visited a new school of the central-hall type in Middlesbrough, a town whose death-rate from lung diseases is very high. On entering one of the classrooms that had just been vacated I found the air so foul that it caused me to draw back, and I noticed that no attempt was made to change the air by opening the windows or in any other way, and the children were allowed to again occupy the room under these very unsatisfactory condi-

*From a paper read at the Congress of the Royal Sanitary Institute, Cardiff, England, July, 1908.

tions, and were expected to do justice to their studies.

My attention was then drawn to the natural system of ventilation, and I have since examined and tested a number of buildings in various parts of the country supposed to be ventilated on this system, and found: Where several ceiling outlets were connected together by metal tubes and led into a so-called central extractor there was a danger of foul air being drawn from one classroom and carried along the tubes and delivered through what was intended to be the foul-air outlet into another room, for the children there to breathe over again.

I believe Dr. Scurfield, Medical Officer of Health for Sheffield, made some tests in Sunderland a few years ago, with somewhat similar results.

Fresh-air inlet wall-tubes fitted with regulating traps were very often closed and sometimes filled with paper and rubbish, and, the flaps being out of sight, had been forgotten. In very cold weather, owing to the heating of some schools being so deficient, every fresh-air inlet was closed, in order to keep the room warm. The same often applied to ventilating stoves, which were closed and had been forgotten. Inlet metal gratings in outer walls were of such design that the metal closed the opening at least 60 or 80%.

Down-drafts were often complained of coming from the ceiling foul-air outlets, connected to so-called roof extractors; and in some cases gas-jets had been placed in the tubes, but these were not sufficient to cause a proper draft. Regulating flaps had been placed in the ceiling outlets; these had been closed to prevent down-draft, and had remained so.

In some cases hinged automatic closing valves were used to prevent down-drafts, and these would sometimes "go wrong"; and in one new school, not twelve months old, every one had "gone wrong," and was closed, and had been for some time. To avoid interfering with the appearance of a building by putting in a number of roof turrets, "secret ventilators" were often used, and for the sake of appearance the children's health was made to suffer, for the very name of "secret" concealed ventilator implies its uselessness.

From my observations and the recent tests made by experts to ascertain the state of the air in the classrooms, I am led to believe that many, if not most, of our modern schools are inefficiently ventilated, and a radical change will have to be made to make them efficient. A mistaken belief in the powers of the many appliances which are now put on the market and illustrated in well-got-up catalogues is partly responsible for this, and too much reliance is placed in so-called roof extractors which trade under the assumed name of "ventilators"—in some cases they would better be called fresh-air inlets.

Dr. George Reid, County Medical Officer of Health, Staffordshire, recently made some tests to ascertain the quality of air in schools built on the central-hall type and those of the pavilion system now being erected in Staffordshire and Derbyshire. The tests showed the air to be very much purer in the pavilion schools than those of the central-hall type, and even better than the plenum ventilated schools of that district.

The standard of purity in the central-hall schools was very far short of that generally recognized. From the complaints made in the central-hall schools it would appear that from a ventilation point of view it is not the most serviceable building, and even from an administration point of view many head teachers have led me to believe that little importance can be placed on the idea of having the head teacher's desk in sight of all the classrooms.

The different systems of ventilating schools may be described as follows:

(a) By means of fresh-air inlets in walls, and in ventilating radiators and stoves fitted with ventilation flaps. Foul-air outlet openings in ceilings connected by means of tubes to so-called roof extractors either on the ridge or "concealed." This system, which appears to be largely adopted, will be known to most of us by its

failures and want of system, and thereby want of ventilation.

(b) Another system, somewhat on the lines of the first one as regards inlets, and having the foul-air outlets in the ceilings connected to a roof turret by ducts formed of wood-framing and plaster. The turret is fitted with an inner framing, the openings of which are covered with silk cloth flaps, which remain closed on the side of the wind and easily open with the current of air passing through the ducts. An outer framing is fitted in the usual way with louvred openings to protect the inner from the weather. The system has proved successful, but is capable of improvement.

(c) In some cases an iron flue from the heating chamber is placed in an upcast shaft, which draws the vitiated air from the classroom by means of ducts with outlets at ceiling and floor levels. The fresh air is warmed by being passed over the heating apparatus, and is delivered at about 8 ft. from the floor level. This system is more elaborate and pretentious than most natural systems, but has met with some measure of success.

(d) In the counties of Staffordshire and Derbyshire a new type of school on the pavilion system has been built to ensure the cross ventilation into the open air of all classrooms, which appears to be the most natural and successful way of dealing with this question. The tests in these schools, taken by Dr. Reid, show the air inside to be practically as pure as that outside. This system of ventilation is by means of hoppers and sash windows on both sides of the room. No appliances of any kind are used, but ventilating radiators are introduced on both sides of the rooms. On the coldest days in winter some of the hoppers are kept open with no discomfort to the scholars. The fresh-air inlets provide six or eight times the area usually required by the board of education. It has been necessary to slightly increase the heating surface on account of the larger quantity of fresh air admitted.

In these schools a system of thorough cross ventilation is obtained, and so a natural system of ventilation exists. All sorts of difficulties were raised by the board of education when the plans for these schools were submitted, and it was only after a deputation had waited on the board that permission was obtained to put up the buildings, which have undoubtedly proved far in advance of those built on the principles recommended by the board. Although several of His Majesty's inspectors have visited these schools privately, yet, I understand, no official approval of them has been given.

There may be some excuse for keeping windows closed where the air is laden with soot and dust, and the air requires moistening, but even then buildings should have their windows made to open. It does not seem natural to teach children to keep windows closed, as the ideas learnt at school are carried into the home, and they should rather be taught to keep windows open and obtain as much fresh air as possible.

Among the buildings of this class which I visited was one recently erected in London for higher educational purposes. Outlets were placed near the ceilings, connected by ducts to a large extracting fan on the roof; and although the fan could be heard working in the rooms below, yet no upward movement of air was noticed, although I tested it in several ways and in a number of rooms. I entered the rooms immediately after an examination had been held, and found it quite a relief to pass out into the open air once more.

The question often arises as to whether schools can be properly ventilated so as to maintain a recognized standard of purity without incurring great expense. The Staffordshire and Denbighshire show us that this can be done, for the amount of added impurity in the schools only averaged 0.23 CO_2 per 1,000 cu. ft.

What I think we want to consider is how to supply our classrooms with plenty of fresh air, so as to scour them as often as possible during occupation. I would suggest:

1. That school teachers be scientifically taught the necessity for keep-

ing the air of the classroom in as pure a state as possible, and the proper use of regulating fresh-air inlets and the need for opening windows on every possible occasion. *(a)* For the sake of the children, to enable them to obtain the maximum benefit of the teaching from an educational point of view. *(b)* For their own sakes, to guard against the lung and throat diseases and excessive death-rate which teachers are liable to. Teachers should understand that fresh air will prevent the spread of disease and growth of organisms which thrive in closed rooms.

2. That a standard of purity be required rather than certain fixed rules as to cubical contents. Any amount of space can be had in a room, and yet the air can be as filthy as it is possible for it to be.

3. That all classrooms be so designed that windows, hoppers, etc., be made to open, and so arranged as to thoroughly scour the room in a few minutes with inlets well distributed. The more inlets there are, the less drafts will be felt.

4. That qualified inspectors be appointed to examine all schools and to regularly test the air to see that the standard of purity is maintained, and that efficient inlets and outlets are provided, and to keep charts of their observations. Such inspectors should be directly under the medical officer for the district. This work should be done by men having a knowledge of school building, and not left to those who have been appointed by virtue of their having previously held some Government appointment in another capacity.

5. That the heating arrangements are such that a reasonable temperature shall be maintained without resorting to extraordinary stoking of fires or boilers.

Here, again, too much reliance is put on the heating power of certain makers' fittings claimed by them. It must be remembered that children often come to school in a half-clad condition, and the want of proper heating has led to the closing of all fresh-air inlets, which might have been left open had the temperature of the rooms been raised to a state of comfort.

A great deal depends upon the surroundings of a school, and not enough attention is paid to the selection of its site. Committees often choose an unsuitable site, and then invite architects to submit designs, which, at the best, from an aspect point of view, leave much to be desired. Advice should be taken before the site is chosen, so as to place the building in a suitable position, with as much fresh air around it as possible, and to avoid playgrounds being overshadowed, etc.

Fresh Air Distribution

By Charles L. Hubbard

The following cuts illustrate some of the various ways of conveying fresh warm air from the heaters to the rooms to be ventilated. They have been selected from the detail plans of a number of different types of buildings, and are given largely as suggestions to be used in the design of new work.

Fig. 1 shows a method for making the connections between an indirect stack and the room register for conditions like those in hospital work, where the basement is used as a cold-air chamber. In this case the mixing damper opens directly into the basement space, taking its cold air from the general supply. This damper is operated from the room above by means of a chain and pulley arrangement, the chain passing out through a catch-plate attached to the register face or to the wall just above it. These pulleys should be full guarded to prevent the chain from slipping off in inaccessible places. The mixing damper should be either stiffened with light angle iron or made of the "pan" form to prevent warping. It should close tightly against flanges, which are sometimes covered with asbestos felting. It is better, however, to make the flanges so true that no packing is required, as it is likely in

time to become worn and brittle, thus being worse than none at all.

If the heater was supplied with cold air through a special duct, the bottom of the casing would be closed in, and the lower side of the mixing damper would connect with the space below the heater; otherwise the arrangement would be the same as that shown in Fig. 1. The warm-air pipe between the heater and the register should be insulated when it runs up in an outside wall as shown. This may be done by wrapping seaweed quilting around the concealed pipe and wiring it in place, and covering the exposed part with plastic material protected by a canvas jacket.

Fig. 2 illustrates the arrangement of heaters and air-ducts in a building where the basement rooms are occupied and it is desired to conceal the heaters and piping. The example shown is from a hospital where there is a basement corridor running the entire length of the building. The upper part of this is utilized as a cold-air supply duct by constructing a light false ceiling as shown. The flues are carried up each side of the corridor (only those on one side being shown) and indirect heaters suspended beneath them as indicated. Two openings are left in the brickwork at each heater, one connecting with the space above and the other below. A mixing damper placed as shown provides means for regulating the temperature of the air flowing to the rooms above.

The supply and return piping is carried in the air space above the false ceiling, and so concealed. When this arrangement is made use of, the space should be of sufficient depth to allow the entrance of workmen for making repairs, should this be necessary. The pipe mains and branches can be erected and connections made with the heaters before the false ceiling is put in place.

Fig. 3 shows a sliding mixing damper to be used at the base of each supply flue in the double-duct system where a fan is used. This damper slides in grooves at the sides of the pipe, and is operated by a chain carried up the flue as shown. The arrangement shown in Fig. 4 is well adapted for use in the case of office buildings, court houses, etc., or where there is a large number of small rooms on each floor to be reached which are not symmetrically placed above each other and thus precludes the use of flues carried up from the basement.

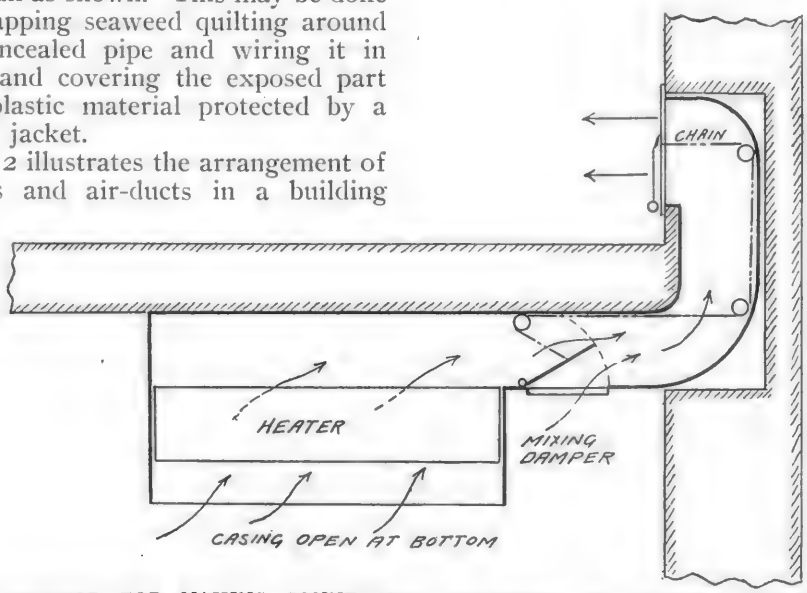


FIG. 1.—METHOD FOR MAKING CONNECTIONS BETWEEN AN INDIRECT STACK AND ROOM REGISTER

In this scheme the distributing ducts are formed by furring down the corridors sufficiently to give the required area. Connections between these airways and the rooms are usually made over the doorways, and the openings provided with lock registers for regulating the air-flow.

These corridor ducts are fed by a

main uptake flue running from the basement to the upper floor and reducing at each story as the load becomes smaller. Dampers should be placed in the connections between this uptake and the horizontal ducts for proportioning the supply to each floor.

The arrangement shown in Fig. 4 is for cases where air at the same temperature is furnished to all of the rooms for ventilation only, heat being provided by other means.

Fig. 5 shows a similar plan for a double-duct system where both ventilation and heating are accomplished by the use of warm air. In this case galvanized iron ducts are required, and are usually placed with the hot air at the bottom and the tempered air above.

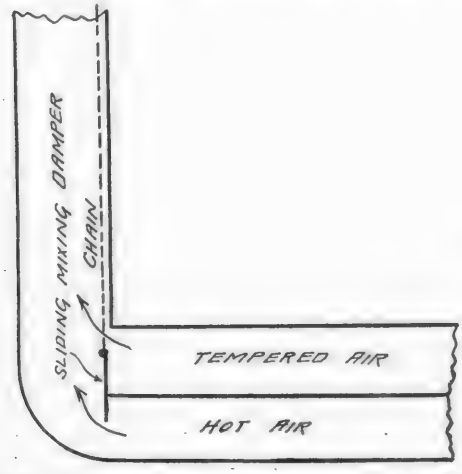


FIG. 3.—TYPE OF SLIDING MIXING DAMPER

The outlets to the rooms are furnished with mixing dampers for regulating the temperature of the discharge. When tempered and hot air are used in this manner it is customary to make the areas of the ducts in the proportion of three-fifths for the tempered air and two-fifths for the hot.

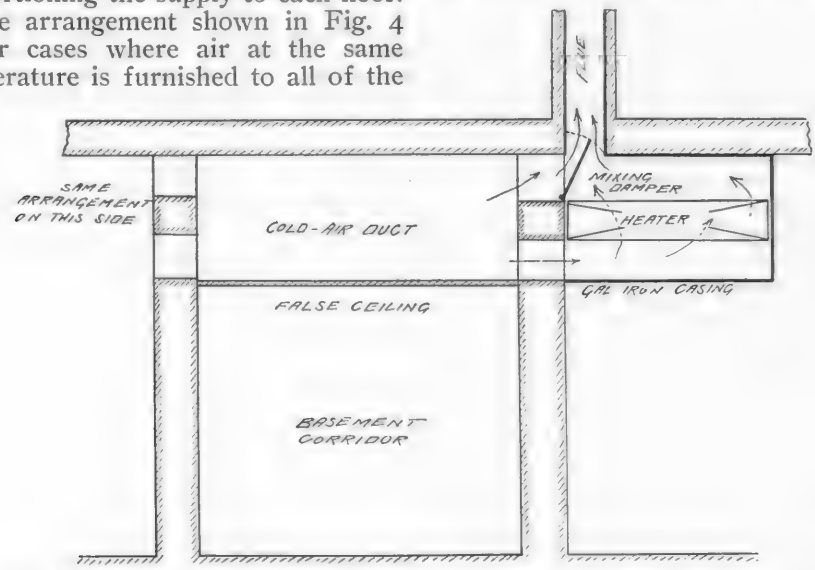


FIG. 2.—ARRANGEMENT OF HEATERS AND AIR DUCTS IN A BUILDING WHERE BASEMENT ROOMS ARE OCCUPIED

Lock registers may be used here as in the case previously described. The mixing dampers may be operated either automatically or by means of chains brought down to convenient points.

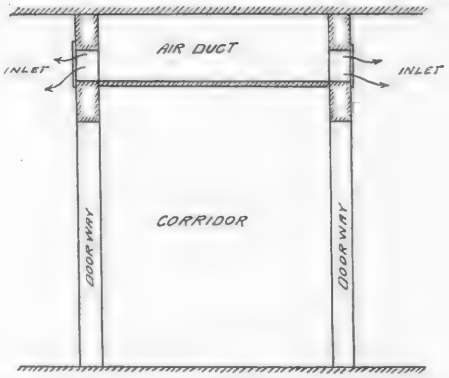


FIG. 4.—CONVENIENT ARRANGEMENT OF AIR DUCT FOR REACHING LARGE NUMBER OF SMALL ROOMS

Fig. 6 shows an arrangement for both supply and discharge ventilation.

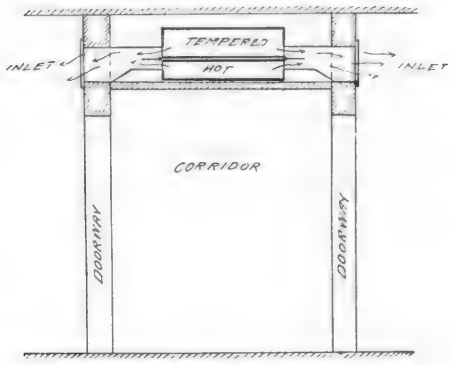


FIG. 5.—SIMILAR PLAN TO THAT SHOWN IN FIG. 4, FOR A DOUBLE DUCT SYSTEM

Here air for ventilation only is supplied, the heating being done by direct radiation placed in the rooms. The fresh air is supplied through a galvanized iron duct with offtakes to the various rooms as shown. The space around the fresh-air duct is utilized for carrying the exhaust ventilation. The vent registers are placed near the floor, and connect with the vent space at the ceiling below as shown. These connections are usually made of galvanized iron built into the partitions. Any danger of leakage of foul air into the fresh-air pipe is avoided because the fresh air is under pressure and the foul air under suction, causing any leakage which may occur to be in the reverse direction. The fresh-air ducts on the various floors connect

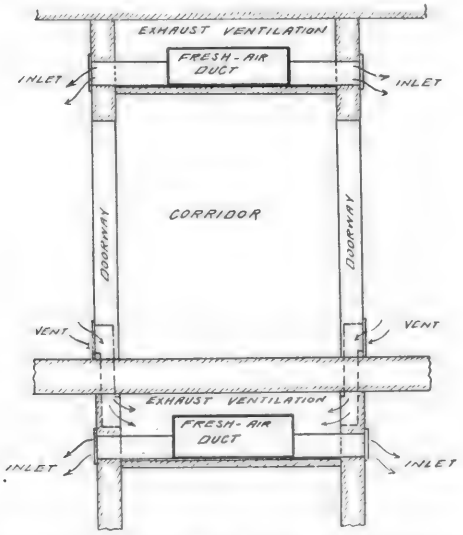


FIG. 6.—ARRANGEMENT FOR BOTH SUPPLY AND DISCHARGE VENTILATION

with a main supply uptake from the basement, and the exhaust spaces connect in a similar manner with a main uptake leading to an exhaust fan at the top of the building.

Fig. 7 shows in detail a very satisfactory way of admitting air to a hall or theater where the seats are placed upon steps or raised platforms and a closed air-space formed between these and the main floor.

By this method the air is introduced through a long slot about an inch in width extending the entire length of each platform riser. The construction is such that the air is thrown down-

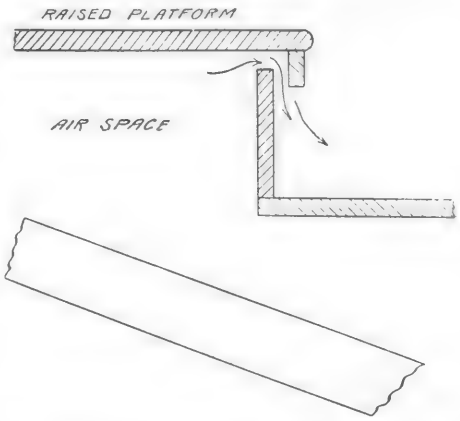


FIG. 7.—ARRANGEMENT FOR ADMITTING AIR IN HALLS OR THEATERS WHERE SEATS ARE PLACED UPON STEPS OR RAISED PLATFORMS

ward, thus preventing appreciable drafts.

One of the most satisfactory methods of supplying a large volume of air to a church auditorium is shown in Fig. 8, which represents a section through one of the pews. This arrangement is best used where there is a raised floor for forming an air chamber under the entire auditorium, although a system of ducts and branches connecting with each pew has been successfully used. Each pew is provided with an air-chamber running the entire length and supplied either at the end or center through an uptake connecting with the air-space or duct below. Air is discharged into the room through a slot running the entire length of the pew, which throws it downward toward the floor. Air sup-

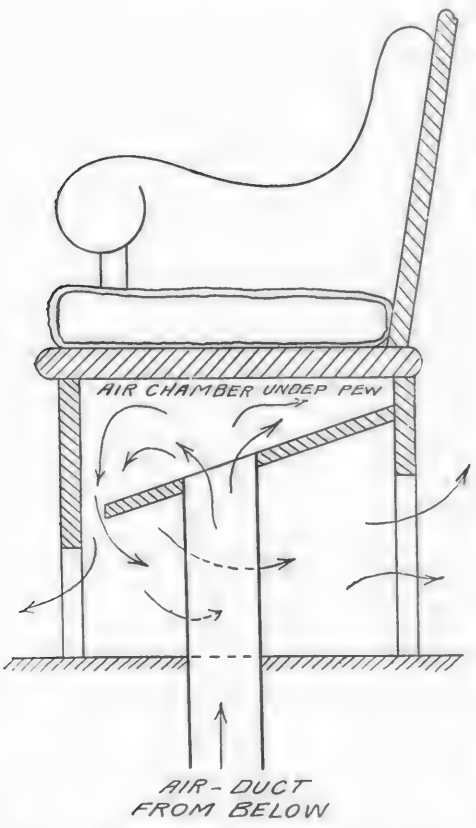


FIG. 8.—METHOD FOR SUPPLYING LARGE AIR VOLUMES UNDER CHURCH PEWS

plied to a church in this way is delivered without drafts or other disagreeable results.

Fig. 9 shows a section through a vent or discharge register connecting with an uptake flue, and illustrates a successful method of preventing back drafts during high winds or at nighttime when the flues become cold.

This result is accomplished by the use of checks or flaps of light rubber gossamer hemmed on both edges and strung on light steel rods wired to the

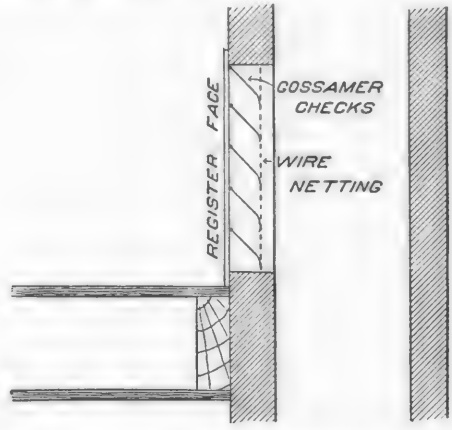


FIG. 9.—METHOD FOR PREVENTING BACK DRAFTS THROUGH DISCHARGE REGISTERS

back of the register face. A wire netting should be placed back of these as shown, to keep them from becoming tangled and to prevent flapping in case of a strong draft. The action of these checks may be steadied by running a light steel wire through the lower hem. When the arrangement is used the register face should be made easily removable, so that the checks may be reached for renewal or repairs.

Exhaust Steam—Its Place in a Division of the Cost of Services in Buildings

By Reginald Pelham Bolton

Among other subjects discussed at a recent convention of building managers, in Chicago, one of particular interest to the heating engineer related to the cost of services in buildings. As heating by means of exhaust steam usually constitutes so large a part of these services, it is becoming more and more important that the charge on the plant in the building for this exhaust steam should be accurately determined. Speaking on this phase of the subject, Mr. Bolton said:

In establishing the cost of the generation of electric current, in combined plants, in which the exhaust is in winter utilized for heating work, a very common method has been to assume that by reason of the utilization of the exhausted steam in the heating service the electrical supply is during the period of the heating

season provided without operating cost.

Such an assumption is defective for several sound reasons. In the first place, the utilization of the exhausted steam must be shown to be complete. It should not be accorded a priority in this respect over the exhausted steam afforded by other apparatus, such as elevated services and house water supply, but should take its place in the order of necessity and of regularity of the amount of exhausted steam supplied, and when thus allotted its place, the extent of its availability can be ascertained by plotting its steam consumption within a scale of the heating requirements of the building.

A STUDY OF VARIATIONS IN TEMPERATURE

A close study of the variations of the work of heating in the eastern part of the country will show that the temperature changes, between night and day, are at all times considerable, and that the temperature is usually higher during the working hours of daytime than at night.

It will be thus be found that the average temperature of the heating season, which is commonly employed in the determination of the requirements for heating, is a false basis for computaton as regards the utilization of exhaust steam, for that portion of the day and evening during which such steam is available requires a less amount of heating work to be done, and has a less capacity for the use of the exhaust just at the time of the largest production of the latter. The following figures derived from the official records of the past thirty-five years, illustrate this point:

Average temperature throughout heating season, New York City, 38° F.

Average temperature at noon, New York City, 45° F.

Average temperature at 3:30 p. m., New York City, 44° F.

Average temperature at 6 p. m., New York City, 41° F.

The variable character of the work usually done in electric lighting brings about uncertain and irregular volumes of exhaust steam, for which there is not always an available use in heating. Thus, the peak loads induced by evening decrease of daylight come at a time at which the demand for heat is about at its least point, and at which, on the other hand, the elevator service is performing its heaviest duty.

In order to reach a desirably correct conclusion, it is necessary to give consideration to the fluctuations of demand and of supply, not only between the hours of the day, but also between the several months of the heating season, in which there is a very considerable difference in heating requirements.

Thus, during the months of October, April and November, in the daytime the temperatures are high, and the work in which exhausted steam is available is attenuated. There is considerable difference between the work required in December and March and that demanded in January and February, and it may be noted that "zero weather" is in New York a rare occurrence, and that the temperature of 0° F. is recorded only at long intervals, and then only at night and in the early morning hours.

WHEN EXHAUSTS ARE IN EXCESS OF HEATING REQUIREMENTS

If we should assume, therefore, a building in which the power for elevators, pumping and lighting was electrically distributed, and was produced by a plant exhausting into the house heating system, we should find that of the total winter exhausts, some portion would be in excess of heating requirements, and that the amount actually utilized formed a moderate percentage of the total heating work.

In drawing a dependable line between respective shares of the cost of fuel, water, supplies and labor, we should find it necessary, first, to establish the relation between steam generated for use as live steam in heating, and steam generated for the production of power, of which a cer-

tain ascertained portion is turned back into heating work.

The value, to the heating part of the building's duties, of the steam so returned is limited to its reduction of the supply of live steam. In other words, its value is just that of a similar amount of live steam raised and used directly in the heating system. The engine and pump cylinders have merely acted as reducing valves, their operation being conducted with a certain loss, by drips, leakage and radiation, made up to some extent by the known advantageous effect in heating systems of saturated exhausted steam.

With how much, then, of the expense of the process of reduction of pressure should the heating of the building be charged?

If the point of view be adopted that the electric supply is produced without cost, then it follows that the whole of the engine room charges are loaded upon the heating work. If the heating were done by one contractor, and the power generation were provided by another, we can readily see how such a proposition would be regarded. The heating contractor would refuse any responsibility for engine room costs, except as represented by the value he would allow off his bill for the exhausted steam returned to him. He would, naturally, claim, for instance, that a reducing valve which required the constant supervision of a certified engineer was unnecessarily expensive, and that something in the automatic line would suit his pocket better. If, however, that engineer's duties were in part exercised to relieve the contractor of the employment of an engineer to supervise the operation of the heating plant, he would, no doubt, be willing to contribute some portion of the cost of his employment.

PROPORTION OF WINTER ENGINE ROOM LABOR

Since, therefore, in a combination of services, such as the modern building requires, part of the supervisory expenses of the engineering staff are necessarily applied to the operation of the heating system, it is fair to assume that the proportion of exhausted steam which is utilized in the heating apparatus carries with it its share of the engine room charges, and the proper proportion of winter engine room labor, which is to be applied to the heating system, becomes that percentage, which the utilized exhaust bears to the total steam required for the heating service.

The balance of winter engine room charges, is, then, to be divided up between the several services, or supplies of power, which it produces, in the proportion which they severally bear to the total output of generated power, or of consumption of steam.

In a combination plant, it would not, however, be necessary nor fair to consider such service as entirely disconnected from the others with which it is combined. The steam raised and passed through the engines back to the heating system is a product of the heating capabilities of the fuel. It may be regarded as a transmitting agent. So far as the engine use of it is concerned, were the engine room to be run by persons independent of the fire room, its cost would certainly be in the neighborhood of a rate of $70 per annum. But as it is, the product of the heat in the coal is returned to the heating system, and it is fair, therefore, to make no charge against the engine plant for the actual heat which it returns.

But the labor involved in its production is a fair charge against the engine plant, for the form in which the heating is done is planned to suit the engine, and might, otherwise, be done by direct heat of the fuel, or, at any rate, by low pressure steam. The convenience of the supply which the engines received is, therefore, represented by the labor and some part of the standing charges, involved in providing the steam as and when required, and in the desired form of pressure and dryness.

It is proper, therefore, that the en-

gine room should be charged with the labor involved in providing the supply of steam which the engines receive. And the engine plant should also be charged with the cost of fuel and water for any part of such steam received and not returned to the heating system.

ESTIMATING FIXED CHARGES

The fixed charges must also be properly treated in a fair manner. Since for the purpose of heating only, the cost of the boiler plant might be less, if it were not for the requirements of the engine plant, it follows that the engine plant should be charged with that proportion of the fixed charges applicable to the fire room, which is represented by all the steam it utilizes *in excess of that which it returns to the heating.*

It is not uncommon to hear similar views as to the contribution of service without cost, expressed by come person more interested in heating, or in elevator work, than in electric lighting. Each, in turn, claims that part of his work is accomplished at no expense, because:

1. The heating point of view regards the exhaust steam as being returned to the system without cost.

2. The elevator point of view regards the steam used to provide elevator power in winter as a gift.

3. The electric light point of view regards the steam consumption of the electrical generating plant as being returned to the heating man, carrying with it all operating and labor costs.

This three-cornered method of dealing with the subject places the power and labor costs in the position of a football, each party denying responsibility, it is charged by each in turn to the other. Manifestly, these points of view are all unfair and inexact, and each service must bear a proper share of the cost.

A development of this process of evasion of responsibility is that of selecting some service out of others, and of estimating the effect by a reduction of coal, water and supplies, but not including any reduction of labor. The assumption is usually made in such cases that the amount and extent of labor, established for the combined plant, can be modified only to a small extent, perhaps not at all, by the elimination of the work of one of the building services.

Such an argument may hold good where the labor is nicely or economically proportioned to the work, or when it consists of very few individuals. And, of course, if the service so eliminated be a minor one, or if an automatic character (such as might be the case, for instance, with a small steam-heated supply of hot water), no economy in labor might follow its elimination.

But, on the other hand, where a new combination can be formed, such as, for instance, might follow the substitution of the supply of steam from another source, it would be manifestly wrong to assume that no reduction can be made in labor cost.

If, in such a case as above supposed, the fire room force could be modified, then in the alternative case of a supply of developed power, some rearrangement of engine room labor should result.

The excellent work is done by the operating staff of many buildings, by repairs of apparatus in and out of the engine room, is sometimes used as an argument against the possibility of a readjustment of the labor.

But a reduction in the operating machinery brings with it a reduction in maintenance and repair work in the engine room, leaving more time for similar work outside the engine room.

The whole subject is one which bears upon, not only the question of the utilization of outside or public services, but upon the intelligent understanding of power and heating economics.

If the due proportion between the several services be once accurately drawn, as herein suggested, the building manager can intelligently follow results reported to him. Without such an apportionment, he can have only a crude and, probably,

very inaccurate idea of the cost of each service in the combination which he controls.

DISCUSSION

MR. KISSELL (Springfield, Ohio): We buy our current at 4 cents and our steam at 30 cents per thousand condensation. I take it from the discussion that the current could be made for less than that if we had our own plant. I would like to know if any of you know about the heat, whether or not 30 cents per thousand condensation is high or low.

MR. REIMBOLD: We have a very high charge for heating in the Twin Cities; our average temperature for seven months is 29½°, that is the average minimum temperature, and we are probably more interested in heating than any other charge for operating buildings, and I have found in all our plants that heat our own buildings, that it has cost us about 28½ cents per thousand pounds of condensation for direct heating. Where we have lighting load and use our exhaust steam, it has cost us about 18 cents, somewhere near there. We have never been able to arrive definitely at the actual cost of heating with a lighting load, but a direct heating plant will cost about 28½ cents for fuel, labor and the interest on the investment. Of course, the coal cost up there is very high. We pay $4.75 a ton for screened lump coal, where that might be bought in Ohio for considerably less than that, but we have all known appliances for heating and it is costing us less than any other city in the country compared with what we have to do. The public service plant up there gets 54 cents per thousand pounds, so your charge of 30 cents is not very bad.

Douglas Galton is quoted as saying that "the permanent absence of ozone from the air can be regarded as a proof that the air is contaminated," meaning that in ozone is Nature's great purifier. Being oxygen in a concentrated form, it is probably a vitalizing agent as well.

Test of Underground Conduit Containing Hot Water Piping

The following is an abstract of a thesis entitled "An Efficiency Test of the Merchants' Heating and Lighting Plant of Lafayette, Ind.," conducted by Messrs. E. Faris, L. J. J. Owens and C. J. Peck, senior students of Purdue University, under the supervision of the chairman of the Committee of Tests of the American Society of Heating and Ventilating Engineers, and read before that Society. It is published apropos of Prof. Hoffman's article on another page of this issue dealing with the same plant.

The system under consideration is a two-pipe hot water system, with flow and return in the same conduit. The conduit is built up of three-ply 1-inch boards insulated from each other by tarred paper, the interior of the conduit being filled with wood chips and then covered with crude oil, as shown in Fig. 1. The conduits were laid in 1902 and when the

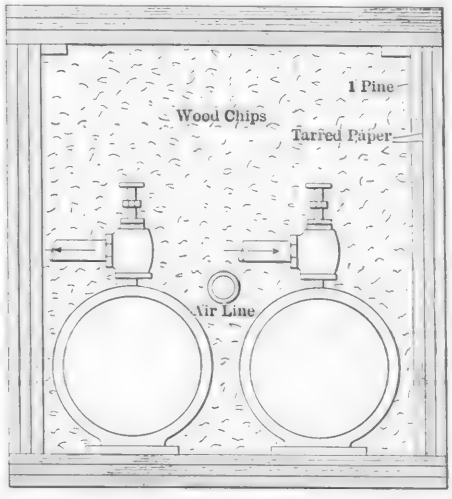


FIG. 1—CONSTRUCTION OF UNDERGROUND HOT WATER CONDUIT

test was conducted they were considered to be in a fair state of preservation.

The capacity of the system was about as follows:

Total square feet of radiation	118,000
Length of conduit in feet—	
10-in. main	450
8-in. main	1,200
6-in. main	4,700
5-in. main	1,700
4-in. main	6,800
Total length of all conduits	14,850
Total length of flow and return mains	29,700

During the test on the conduit the following average conditions prevailed:

Duration of first test on conduit, in hours	10.

TABLE I.—RECORD OF OBSERVATIONS

Time	Pitot Tube No. 1			Pitot Tube No. 2		
	Height in Ins. of Mercury.	Temperature.	Corrected Temperature.	Height in Ins. of Mercury.	Temperature.	Corrected Temperature.
10.15	1.7-16	151	153	1-4	146	149
10.30	1.1-2	150	152	3-16	146	149
11.30	1.7-16	152	154	1-4	147	150
12.30	1.7-16	156	158	5-16	151	154
1.30	1.1-2	155	157	9-32	151	154
2.30	1.1-2	159	161	3-16	156	159
3.30	1.1-2	159	161	1-4	155	158
8.30	1.1-2	160	168	5-16	156	159
Average....	1.4765	155.2	157.2	0.2539	151.	154.

Pressure in flow main, pounds per square inch 60.6
Pressure in return main, pounds per square inch..... 32.23
Barometer, inches of mercury..... 29.5
Temperature in flow main at plant, degrees F 158.36
Temperature in return main at plant, degrees F.....140.66
Outside temperature in degrees.... 31.2

To determine the heat losses from the conduit a Pitot tube was placed in the main 10-inch flow pipe at the plant and a similar tube, shown in Fig. 2, was

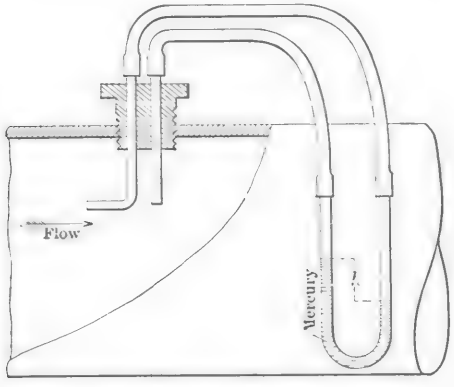


FIG. 2—APPARATUS FOR DETERMINING VELOCITY OF WATER IN UNDERGROUND CONDUITS

placed at point *X* in the 8-inch flow pipe at a distance of 1,582 feet from the first tube. The velocity of the water passing each point was then calculated from the observed data. These readings are shown in Table I.

The results obtained from the above readings are as follows:

Velocity of water at plant, feet per second 7.336
Velocity of water at point X. feet per second 3.046
Water passing point X, gallons per second 7.95
Water passing point X, lb. per sec. 64.83
Drop in temperature from plant to point X. degrees..... 3.2
Drop in temperature per 1,000 ft. of conduit, degrees..... 2.022
B. T. U. lost by water from plant to point X per hour.....746,840
B. T. U. lost by water per 1,000 ft. of conduit per hour.....472,090
B. T. U. lost by 1 lb. of water per 1,000 ft. 2.022
Per cent. of heat gained in the plant, lost per 1,000 ft. of conduit 11.4

The loss from the return main would be less than the above, because of a somewhat lower temperature of the water. Suppose this loss to be only 8.6 per cent. (a very safe figure), then the total heat loss from the conduit per 1,000 feet is 20 per cent.

The above figures may be considered of value only for the one condition as stated. Conduits containing pipes of other sizes would probably have heat losses varying greatly in amount from that shown on the one carrying the 8-inch pipe. The results, however, do not show that in the average conduit, with pipes insulated as these are there is a considerable loss of heat during transmission.

Effect of Open Windows With Mechanical Ventilation

The effect of lowering the window from the top in a crowded school room with an ample supply of pure air through an overhead register is described as follows: The circulation of pure air will be almost entirely overhead. The carbonic acid given off by the pupils will at first ascend and will be caught in the outgoing currents. But most of the organic matter, which is the more deadly form of crowd poison, because cooler and heavier, will remain in the lower and occupied stratum of air.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

DATE SET FOR ANNUAL MEETING

At a meeting of the Board of Governors, held September 24, at the office of Secretary W. M. Mackay, 113 Beekman street, New York, the date for the next annual meeting of the society was set for Tuesday, Wednesday and Thursday, January 19, 20 and 21, 1909. The professional sessions will be held in the Engineering Societies Building, 29 West 39th street, New York.

COMMITTEE ON NEW YORK STATE FACTORY VENTILATION

The final makeup of the committee which will work for the maintenance of the new factory ventilation law in New York State is announced as follows: Chairman, Prof. William Kent, Syracuse, N. Y.; Prof. R. C. Carpenter, Ithaca, N. Y.; William Mackay, New York City; William C. Vrooman, Schenectady, N. Y., and E. P. Bates, Syracuse, N. Y.

COMMITTEE TO COLLECT DATA ON AIR WASHERS

President James Mackay has announced the appointment of Mr. S. R. Lewis, of Chicago, as chairman of the Committee to Collect Data on Air Washers, vice Stewart A. Jellett, resigned. The name of Theodore Weinshank, of Indianapolis, has been added to the committee.

Annual Meeting of Illinois Chapter

The Illinois Chapter of the American Society Heating and Ventilating Engineers held its annual business meeting and election, October 12, and from the large attendance it is evident that the same interest in the Chapter's affairs which made the meetings so successful last fall, still prevails.

Reports by the various officers, telling of past accomplishments, and plans for the future, brought forth many expressions of approval, and the installation of the new officers for the coming season was the occasion for several clever speeches. A vote of thanks was given the outgoing officers for the excellent way they have handled the affairs of the Chapter during the past season.

The new officers of the Illinois Chapter elected at this meeting are as follows:

President, George Mehring.
Vice-president, Edmund F. Capron.
Secretary, John F. Hale.
Treasurer, August Kehm.
Board of Governors, James Mackay, R. A. Widdecombe and Samuel R. Lewis.

Although no positive statement has been given out as to the nature of the coming meetings, it is intimated that some surprises are in store for the members as arrangements are being made for meetings at which prominent engineers will be the speakers of the evening.

Annual Meeting of Eastern Supply Association.

Following are the new officers of the Eastern Supply Association, elected at its annual meeting, held at the Hotel Astor, New York, October 14:

President, P. M. Beecher, Pierce, Butler & Pierce Mfg. Company, Syracuse.
First Vice-President, John A. Murray, New York.
Second Vice-President, F. H. Locke, Locke, Stevens & Co., Boston.
Treasurer, F. A. Bucknam, Nason Mfg. Company, New York City.
Secretary, Frank S. Hanley, 261 Broadway, New York City.
Board of Directors: P. M. Beecher, John A. Murray, F. H. Locke, F. A. Bucknam, J. P. Fell, Buffalo; John Reid, New York; John McClure Chase, Philadelphia; John McPhail, Baltimore; Walter Walls, Philadelphia; W. L. Blake, Portland, Me.; and G. R. Adams, Rochester, N. Y.

The Drying of Tobacco

By THEODORE WEINSHANK

The question was asked me some years ago by a tobacco raiser who said: "It takes us too long to dry our tobacco. We put it in bunches, hang it up in a room and there it hangs until it is dry. Sometimes it gets too dry and we cannot pack it until we moisten it again." I told him if he was willing to spend the money I would experment with it and guarantee success if he would go far enough. He said to go ahead.

We built a room 100 ft. long and 8 ft. wide and 9 ft. high. We first started with a canvas belt and later changed to a wire belt, made with ordinary mesh about the size of screening. The belt was continuous, the tobacco being fed at one end and coming out at the other end dry enough to pack. We started with a temperature of 70°, changing the air in that tunnel every five minutes. Then we increased the air supply to once in every two minutes and finally got down to a one-minute change. We then increased the temperature to 90°, then to 110°, and then back to 80° and there we stayed. The tobacco would travel through that room in about 1¼ minutes. The speed of the belt was such that by carrying the tobacco the length of the building in 1¼ minutes, the tobacco attained the proper dryness by the time it reached the discharge end.

THE HEATING AND VENTILATING MAGAZINE

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TO THOSE disposed to look into the future, the present evolution of steam and hot water heating practice affords unusual opportunities for speculation. There are certain tendencies, moreover, that the thoughtful heating engineer cannot afford to ignore. Probably the most noticeable of these is the growing custom of heating groups of buildings either by steam or hot water supplied from a central heating plant. While the East has seen but comparatively little of this type of heating system, the wide use of central stations in the Middle Western States has led to the open prediction that the time is not far distant when we will buy our heat for our homes as well as for our office buildings very much the same as we now buy our gas, water and light. The prediction is made that when that time arrives, the entire country will be dotted with power plants whose function will be to supply the localities in which they are located with light and power and the additional commodity, heat.

JUST what effect such an outcome would have on the status of the heating engineer is another question, but it, also, is full of interesting possibilities, all looking towards the raising of the profession to an even higher plane than it now occupies. Certain it is that the heating engineer of the future must be also a mechanical engineer, while still possessing the distinctive training that has made of the heating field a profession in itself.

THE importance of the situation is strikingly emphasized in an article presented on another page of this issue, dealing with a test of a successful central station hot water heating plant. That such a system can be proved to operate with so high a degree of efficiency and economy is, in the light of present tendencies, a matter of much significance and will call for a revision of opinion on the part of many who are constitutionally opposed to the central station idea in heating work. We feel fortunate in being able to present this paper, especially as the test in question was made directly under the supervision of Professor Hoffman, thus adding to the methods used and the results obtained a reliability that may be accepted with confidence.

FOLLOWING is a typical expression of opinion which bears out the statements made as to the future of the central station system of heating: "I believe we are coming more and more to central station heating, es-

pecially in the cities and larger towns, for first-class residences, business blocks and apartment houses. Our large office buildings are really small towns in themselves and need power, heat, light and water service; hence they are capable of sustaining plants of their own with possibly more economy than if compelled to buy such service from a number of different companies. It will be some time before the large building will succumb to the inevitable. In such buildings, however, steam heat must replace hot water heat, while in smaller buildings it is at present about a stand-off."

WHAT is really another phase of the same subject is presented in the article in this issue relating to the cost of services in buildings. Here the viewpoint is from the other end of the line, so to speak. One statement of the author is of special pertinence in connection with a question raised recently as to the matter of using average outdoor temperatures in various localities as a basis for figuring heating requirements. Incidentally, it shows the importance of such information as is contained in the weather charts published in THE HEATING AND VENTILATING MAGAZINE during the heating season.

"A close study of the variations of the work of heating in the eastern part of the country," says the writer, "will show that the temperature changes, between night and day, are at all times considerable, and that the temperature is usually higher during the working hours of daytime than at night. It will thus be found that the average temperature of the heating season, which is commonly employed in the determination of requirements for heating, is a false basis computation as regards the utilization of exhaust steam, for that portion of the day and evening during which such steam is available requires a less amount of heating work to be done, and has a less capacity for the use of the exhaust just at the time of the largest production of the latter.

"The following figures derived from the official records of the past 35 years, illustrates this point:

Average temperature throughout the heating season, New York City .....38° F.

Average temperature at noon, New York City.....45° F.

Average temperature at 3:30 P. M., New York City.....44° F.

Average temperature at 6 P. M., New York City.....41° F.

In order to reach a desirably correct conclusion, it is necessary to give consideration to the fluctuations of demand and supply, not only between the hours of the day, but also between the several months of the heating season, in which there is a very considerable difference of heating requirements.

"Thus during the months of October, April and November, in the daytime the temperatures are high and the work in which exhausted steam is available is attenuated. There is considerable difference between the work required in December and March and that demanded in January and February, and it may be noted that zero weather is in New York a rare occurrence, and that the temperature of 0° F. is recorded only at long intervals, and then only at night and in the early morning hours."

Identification of Power House Piping by Colors

A DISCUSSION OF WILLIAM H. BRYAN'S PAPER READ BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

MR. G. F. MITCHELL.—The engineering profession should feel grateful to Mr. Bryan for placing before this society a subject worthy of more attention than has been given it in the past. If its importance is fully appreciated it will lead to the adoption at this time of a standard color code.

The scheme in general is so well covered by the paper that a few suggestions from the members covering points which may appear to have been omitted or which they know from actual experience tends toward simplicity without loss of efficiency, should help in the adoption of a standard.

It seems to the writer that one color should stand for all high pressure steam lines, whether for main engines, auxiliary engines or Holly drip; the same being true also for all exhaust or low-pressure lines.

If found advisable to distinguish between pipes leading to the main engines and those of auxiliary engines, in place of using different shades of the same color, which after months of service might be hard to pick out, could not the main engines be numbered, 1, 2, 3, or A1, A2, A3, etc., and the auxiliary engines 01, 02, 03, or B1, B2, B3, etc., and these designations be placed at the point of an arrow marked on the pipe showing direction of flow in the pipe? This would reduce the number of colors.

I believe also some distinguishing mark could be used to separate saturated and superheated lines and still use the same body color showing high pressure steam. Assume, for example, that red is adopted for a high-pressure pipe line. If this pipe line was for superheated steam, it might be indicated by a black circle containing a white letter "S" placed at the point of the arrow indicating direction of flow. Another pipe line for high pressure saturated steam would also be painted red, but at the points of the arrows there would simply be a number indicating the engine or auxiliary to which it was connected, as mentioned above.

This scheme requires but one color for all high pressure steam lines, and when possible I believe the darker colors should be used in the boiler room, as the lighter ones will become easily discolored, owing to the nature of the work around a battery of boilers.

A standard color chart hung in the chief engineer's office or under the licenses of engineers and firemen would prove a ready reference.

There is one other point I believe should be considered at this time, as it bears a close relation to all power house piping, and that is valves. Some valves open right-handed and some left-handed, and while the writer is firmly of the opinion that only rising spindle valves should be used in important work, there are many places where such is not the case, and even though the valve manufacturer is to-day marking in some way the "direction of closure," are they marked so prominently that in emergency cases, where seconds often count, the operator can feel sure of this direction? Can we not mark valves so that the direction of closing cannot be mistaken?

MR. FREDERICK W. SALMON.—It appears to me to be beyond question that we need and should have at the earliest possible date a standard system of marking piping in power plants both by colors and by certain conventional lines on drawings and plans.

I think such a system should be uniform throughout this country, if not throughout the world and in government work as well as private work, and further it should include simple markings for the different kinds of valves and cocks, such as single gate, double gate and globe valves, plug cocks, etc.

I would strongly advocate the use of conventional lines and marks which may be put directly on the tracings of a power plant, steamship, distillery or whatever the drawing may apply to, and so appear clearly on every blue print or copy issued from it; and to further its general use the system should be very simple and the lines or marks easily made with the ordinary drawing instruments.

It would be advantageous to have small pieces of thin tracing cloth or paper, about 2 in. by 3 in., printed in black ink, with heavy faced type, stating that the A. S. M. E. standard piping marks are used on that drawing, and giving below the conventional marking and lines, and also stating the corresponding color. One of these labels could be secured by transparent varnish to each tracing on which piping appeared, so that draftsman working upon the drawing would always have the table before him, and a correct copy of the table would appear on every print made from it.

If the insurance companies were brought to realize the value of such safeguards to property and life as this, it is possible they would arrange a schedule of rebates to be applied to risks where such useful schemes were in use, and these rebates in turn would influence the adoption of safeguards.

MR. JOHN W. LIEB, JR.—This paper is of a character not requiring extended discussion, as it speaks for itself.

The need of some conventional method of indicating the uses to which the different pipe lines are put in power plants is obvious. The importance of continuity

of service in the conduct of power plants is paramount, and therefore the necessity of meeting promptly any emergency that may arise is evident. It is undoubtedly true that such a system as indicated in the paper would go far toward achieving such a result. It is evident, however, that because of the different kinds of service it has been necessary to cover, it would be very difficult to arrive at a sufficiently comprehensive scheme without exhausting all the prismatic colors. Stencils also should therefore be used, indicating by lettering the detailed use of the pipes; but this should not prevent the adoption of a general color scheme.

This is a matter which might well be made the subject of standardization, and the only question is whether the matter has been sufficiently considered in all its phases to be ripe for standardization at the present time.

It would appear to me that following the suggestion made by the writer of the paper, this matter might well be laid before the council of the society for their consideration before action is taken leading to the appointment of a committee; and I would therefore move that the suggestions made in this paper as to the formulation of a code of symbols for power house piping be referred to the council of the society for consideration.

[This motion was seconded by Mr. L. D. Burlingame.]

Mr. George A. Mattsson.—This coloring of pipes has been done on every steamship on the Great Lakes.

Information Regarding Vacuum Heating Patents

The following statement has been issued by the Paul Steam System Co., of New York, through its president, James E. Heg:

To All Whom It May Concern:

It is important that the heating trade and the general public become acquainted with the patent situation relating to vacuum steam heating, so that they may take proper steps to protect themselves from liability and suits for infringement.

The inventions and patents owned by the Paul Steam System Company are fundamental and include every vacuum system of steam heating having any kind of a pipe leading from the radiator and connected with a vacuum pump or other exhausting apparatus, and containing a valve or other means for permitting the escape of air or air and water while automatically restricting or preventing the escape of steam.

Few people realize the breadth and scope of these basic patents, and it is for those interested that we issue this notice.

We have instituted numerous suits against infringers, which we believe could have been avoided if such infringers had understood the patent situation.

Thousands of dollars have been spent in these suits, and there has already resulted on the part of many of the infringing defendants an acknowledgment of the validity of our patents, and the payment of costs and damages upon their realizing and understanding the scope of our patents and their liability thereunder.

The mere fact that an inventor may be able to construct and patent an automatic valve does not entitle him or others to the right to use such valve in connection with a vacuum heating system like that described. Such use constitutes an infringement of our patents. This fact is made clear by the following illustration:

The telephone was invented by Alexander Bell, and he secured a basic patent upon the apparatus and method for transmitting speech. His invention included, for example, a transmitter and a receiver. After his invention a large number of transmitters and receivers differing in construction from his were invented and patented, but neither the inventors nor any one else was permitted to use these receivers or transmitters in a telephone system for the purpose of transmitting speech, for the reason that the system infringed Bell's patent.

The same condition is present in the vacuum steam heating system. A number of automatic valves have been invented, but they cannot be used on a vacuum steam heating system of the kind herein described without infringing our patents. This fact is strikingly exemplified by the licensees of the Paul Steam System Company. There are, for example, several vacuum heating companies licensed to operate and do business under our patents. These companies have among them over 125 different patents on valves and apparatus relating to vacuum heating systems, and yet these people, in spite of these patents, have been convinced that they cannot use their patents without infringing the patents of the Paul Steam System Company, and they have consequently taken licenses under our patents, and have paid us large sums of money for the right to use their particular valves in our vacuum heating system.

We are, therefore, obliged to protect these licensees who have paid us, and are now paying us this money, and we shall continue to use all proper legal means to protect them and our patents, and all infringers will be vigorously prosecuted.

In order that innocent parties may not suffer, however, we feel in duty bound to issue this statement of our rights.

This company does not itself install heating systems, but, in view of the fact that other companies have licenses under its patents, it is compelled to protect them, there being no other course open to it.

We would advise architects and contractors to carefully scrutinize all propositions made for installing vacuum heat-

ing systems, and to insist upon proof that the basic patents herein mentioned are not infringed upon, thereby avoiding the liability of expensive litigation, and annoyance to their clients and customers, and assisting us in preserving our rights and protecting those of our licensees.

The Weather for September

All sections of the country report higher temperatures than usual during September. Chicago had the warmest September in the history of the Weather Bureau. The feature of the month, however, was the extraordinary lack of rain, which caused excessive dry spells in many places.

NEW YORK

Highest temperature during the month, 83°, on the 19th; lowest temperature, 53°, on the 30th; greatest daily range, 20°, on the 9th; least daily range, 6°, on the 20th. Mean temperature for the month, 68°, 2° above normal for this month for 38 years. Total rainfall, 1.60 in., 2 in. less than usual. Total wind movement, 6,430 miles, mostly from the northeast.

BOSTON

Highest temperature, 88°, on the 11th; lowest temperature, 47°, on the 30th; greatest daily range, 26°, on the 9th; least daily range, 5°, on the 2d. Mean temperature for the month, 66°, 3° above normal for 38 years. Total rainfall, 0.68 in., 2.6 in. less than usual. Total wind movement, 6,696 miles, mostly from the southwest.

PITTSBURG

Highest temperature, 91°, on the 12th; lowest temperature, 40°, on the 30th; greatest daily range, 38°, on the 18th; least daily range, 15°, on the 27th. Mean temperature for the month, 69°, 2° above normal for 38 years. Total rainfall, 0.71 in., 2.7 in. less than usual. Total wind movement, 4,582 miles, mostly from the northeast.

CHICAGO

Highest temperature, 92°, on the 11th; lowest temperature, 36°, on the 29th; greatest daily range, 35°, on the 27th; least daily range, 6°, on the 14th. Mean temperature for the month, 71°, 6° above normal for 38 years. Total rainfall, 2.08 in., 1 in. below normal. Total wind movement, 9,105 miles, mostly from the southwest.

ST. LOUIS

Highest temperature, 90°, on the 13th; lowest temperature, 38°, on the 29th; greatest daily range, 33°, on the 27th; least daily range, 6°, on the 4th. Mean temperature for the month, 73°, 3° above normal for 36 years. Total rainfall, 1.24 in., 2.6 in. less than usual. Total wind movement, 5,167 miles, mostly from the south.

A Personal Tribute to the Late John Henry Mills, M.E., of Boston, Mass.

BY JOHN ALBERT FISH, BOSTON

John Henry Mills died October 6, 1908, at Faneuil, Mass. (a suburb of Boston), aged 74 years. For the past two years he had been in failing health, and for the past two months had suffered much from a throat disease from which he finally succumbed.

To the older generation of persons engaged in the heating business, and perhaps to some of the younger members of the profession, the late Mr. Mills was well known as an authority on heating and ventilation, a skillful mechanical engineer, an inventor and maker of cast-iron boilers, some of which at the present time are made and sold under his own name. Mr. Mills was also an author, and had written many books on heating. Among his best efforts in this direction is his well-known work "Heat."

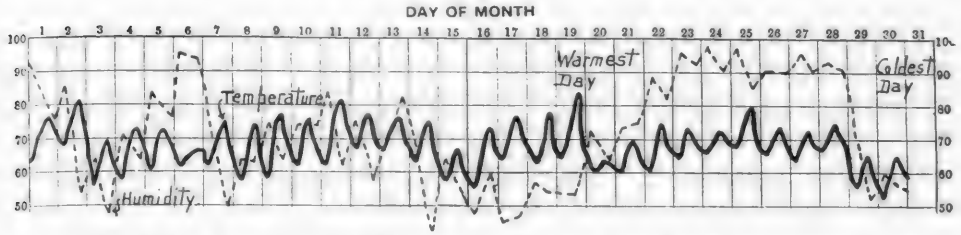
Mr. Mills devoted much time and work to the compilation of these books, and the amount of data collected, the valuable tables, the experimental work involved by the setting up of (actual test) apparatus, and observation has added to his fame in an indelible way not soon to be forgotten.

I venture to say that hundreds of copies of these valuable works occupy a place in the offices and libraries of the heating engineers to-day, and are often consulted.

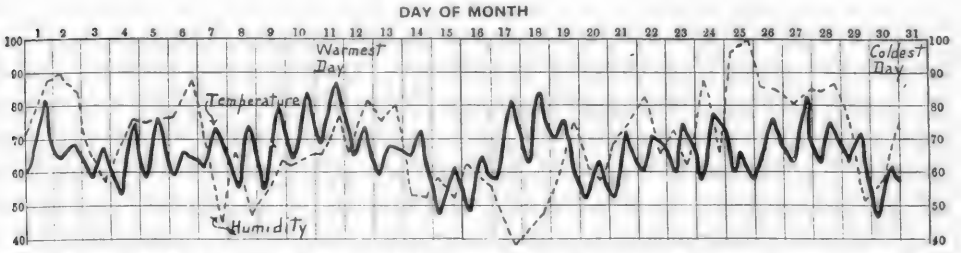
The writer first became acquainted with Mr. Mills in the year 1877, being introduced to him by the late C. C. Walworth, of the Walworth Manufacturing Company, of Boston.

About this period Mr. Mills had invented and was introducing in the United States his one-pipe or overhead system of heating (so called then). He was also introducing with great energy and enthusiasm the use of the Mills cast-iron boilers. At this time there was intense opposition and prejudice to the use of cast-iron boilers for heating purposes, and all manner of criticisms and objections were heaped upon them. Mr. Mills never flinched, but forged ahead, making patterns and getting his castings made as best he could in foundries not so well equipped in those days as now for the making of large boiler castings. He experimented, tested and tried his boilers to the point until in a test one was exploded and Mr. Mills very nearly lost his life, and bore to his dying hour the marks and scars of the accident.

But, nothing daunted, Mr. Mills still believed in the efficacy of cast iron for boiler constructions, and never yielded his opinion. He was largely instrumental in bringing to the front the use of modern cast-iron boilers for both power and general heating purposes, and made many valuable improvements in them. He also devoted considerable thought and study



TEMPERATURE AND HUMIDITY RECORD FOR NEW YORK FOR SEPTEMBER, 1908



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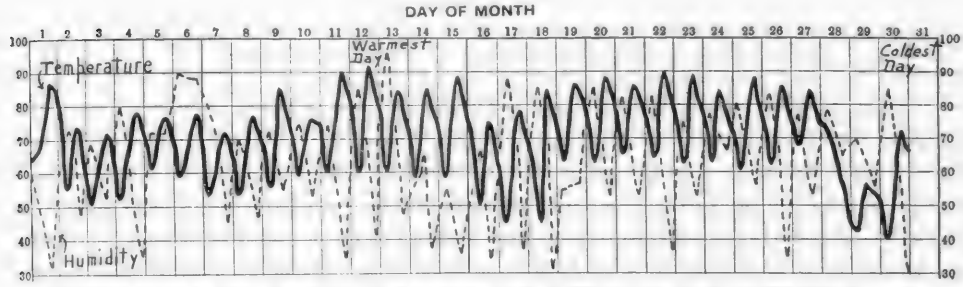

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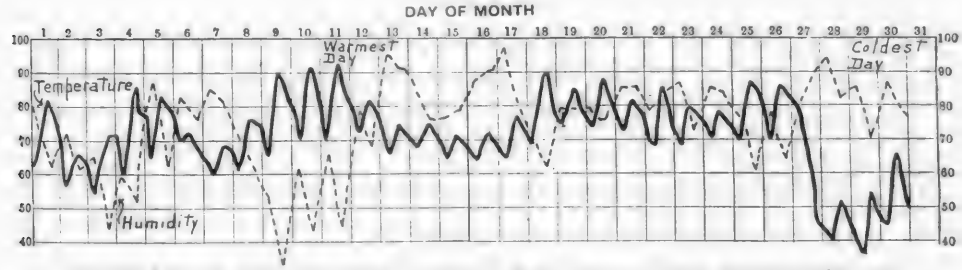
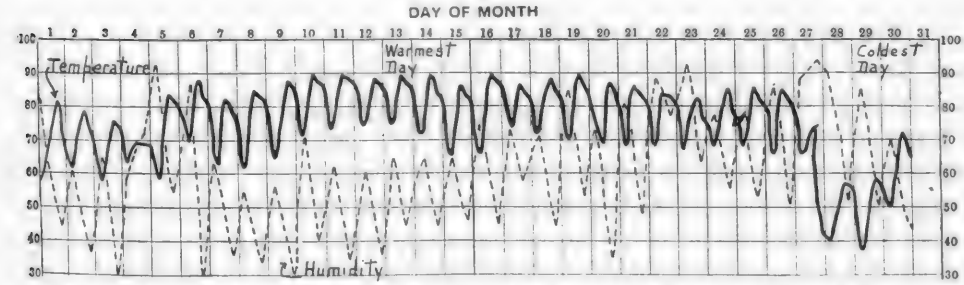


TEMPERATURE AND HUMIDITY RECORD FOR CHICAGO FOR SEPTEMBER, 1908



TEMPERATURE AND HUMIDITY RECORD FOR ST. LOUIS FOR SEPTEMBER, 1908

to the best means of mechanical ventilation, and constructed many special ventilating fans for that purpose. In a general way he endeavored to benefit the art of heating and get the best out of it, and he generally succeeded.

Mr. Mills was in 1877 engaged by the firm of Wisdom & Fish, St. John, N. B., to act for them as consulting engineer, taking up his residence in St. John for a considerable time, introducing his one-pipe system of heating and Mills cast-iron sectional boilers in that city.

I have good reason to think that the association of Mr. Mills with our firm at St. John in 1877 first developed his taste and ideas along the line of heating by hot-water circulation, for it was while employed in St. John that he first came in contact with the modern hot-water heating apparatus as employed there, and had an opportunity to see, study and compare results of the water apparatus versus steam.

After leaving New Brunswick he resided in Buffalo, being connected with the firm of Hart, Ball & Hart, of Buffalo, and later (I think) with the E. H. Cook Company, of Rochester, N. Y., both large and influential heating concerns of their day, and introduced the hot-water heating system in western New York. Later he took up his residence in Boston, Mass., and did more or less engineering work, usually of a difficult and problematical character.

No problem pertaining to heating apparatus seemed too difficult for him to endeavor to solve and work out. Many engaged in the heating business have been benefited by his timely and friendly advice, and I feel sure he will be much missed by the heating fraternity, of which he was always a valuable and popular member.

Mr. Mills had an extensive acquaintance with the leading architects and heating profession generally. He was a man of integrity, very energetic, social and kind in nature, with firm opinions and progressive ideas, of resourceful mind and great inventive genius.

He had designed many large systems of warming and helped many a young heating engineer and others in the profession to unravel knotty problems.

Among some of the large buildings he planned for hot-water heating and superintended in their construction were the Hampden County Jail, Springfield; Trinity Church, Boston; Peirce building, Copley Square, Boston; Tremont Temple, Boston, and many others, too numerous to mention.

Under a bright blue sky and in the light of God's warm sunshine, on October the eighth, nineteen hundred and eight, I saw laid "At Rest" at "Mount Auburn" the mortal remains of our much-lamented friend and companion. May he rest in peace.

Current Heating and Ventilating Literature

Under this heading will be published each month an index of the important articles on the subject of heating and ventilation that appear in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

CAR HEATING

Ventilating and Heating of Coaches and Sleeping Cars. From the report of a committee to the Master Car Builders' Assn. Review of the various systems used and describes the present standard arrangements of the Pennsylvania R. R., the Pullman system, and others, discussing proposed improvements. Ills. 8500 w. Ry & Engng Rev—July 18, 1908. Serial, 1st part. 20c. August 1, 08, 5800 w. 20c. 2d part.

COOLING SPRAYS

Cooling Condensing Water by Means of Spray Nozzles. Illustrated description of this system. 1500 w. Power—July 14, 1908. 20c.

ELECTRIC HEATING

Heating and Ventilating by Electricity (Le Chauffage et la Ventilation par l'Electricité). R. Périssé. A review of methods and appliances. Ills. 2800 w. Bul Soc d'Encour—May, 1908. $1.20.

STEAM HEATING

The Movement of Damp Steam in Long Pipe Lines (Ueber die strömende Bewegung nasser Dämpfe in langen Leitungen). R. Trautmann. Ills. 5000 w. Gesundheits-Ing—June 20, 1908. 60c.

SUBWAY VENTILATION

Cooling and Ventilating the New York Subway. Abstract of the fifth report of Bion J. Arnold, which considers proposed new methods of cooling. 2,500 w. Elec Ry Jour—Aug. 29, 1908. 20 cents.

HEATING AND VENTILATING OF SHIPS

The Heating and Ventilating of Ships. Sydney F. Walker. Int Mar Eng—August, 08. 13 figs. 4,300 w. 40 cents.

HOSPITALS, HEATING OF

Notes on Hospital Heating. C. H. Cooper. Jl Soc Arch—Aug., 08. 400 w. 40 cents. Abstract of a paper read at the Royal Sanitary Institute Congress, Cardiff, July, 08.

SCHOOLS, HEATING AND VENTILATION OF

Heating and Ventilation of School Buildings. Walter B. Snow. Power—Aug. 4, 08. 4 figs. 2,700 w. 20 cents. Discusses regulation of temperature; importance of location of registers; velocity and volume of air required to insure healthful ventilation.

THEATER, HEATING AND VENTILATION OF A

Heating and Ventilation of the Brooklyn Academy of Music. Eng Rec—July 25, 08. 3 figs. 4,800 w. Aug. 1. 2 figs. 3,200 w. Each, 20 cents.

EXHAUST GAS HEATING

A Heating System Utilizing the Waste Heat of a Gas Engine. F. C. Tryon. Describes a successful system of utilizing the waste heat for heating the buildings. Ills. 1,000 w. Power—Aug. 4, 08. 20 cents.

HOT-WATER HEATING

Combined Power and Hot Water Heating Plant. Charles L. Hubbard. Illustrated description of the arrangement of the special apparatus and operation of the plant. 1,500 w. Power—Aug. 25, 08. 20 cents.

The New York Steam Fitting Company

The removal of the New York Steam Fitting Company to its new and well-equipped quarters at 100 Washington street, New York, calls renewed attention to the growth and career of one of the prominent contracting firms in the field of heating and ventilation, power plants and high-pressure piping.

The New York Steam Fitting Company was organized as a co-partnership in 1887 as an adjunct to the Hall Steam Power Co., for the purpose of performing repair work in connection with the operation of the steam plants under the control of the Hall Steam Power Co. The co-partnership was comprised of George F. Hall, father of the principals of the present firm; George E. Hall, a brother, and the late Harry W. McVickar, who was then associated with the late Colonel S. V. R. Cruger.

In 1892 the company was reorganized and incorporated under the laws of the state of New Jersey, Burton P. Hall joining as a director and Henry L. Hall as secretary. The company then entered the field as a competitor for contract work for the installation of power plants, steam heating and ventilating.

Burton P. Hall received his technical education at Stevens Institute, Hoboken, N. J., while Henry L. Hall is from the School of Mines, Columbia University, of New York. In 1897 Messrs. B. P. and H. L. Hall purchased the interests of G. F. Hall, G. E. Hall and H. W. McVickar. In 1901, at the close of the Spanish-American War, Robert E. Hall resigned his commission as chief engineer in the United States Navy and became a stockholder of the company, and was subsequently elected secretary. R. E. Hall is also a graduate of Stevens Institute. The other officers elected at that time are Henry L. Hall, president, and Burton P. Hall, treasurer.

This company executed the heating contract only for the great department store occupied by the Macy Company and the heating and ventilating for many of the large modern public schools. The Academic group of buildings for the United States Naval Academy, Annapolis; the new Police Headquarters, New York City; the Whitehall building, Bowling Green; the Maritime building, Bowling Green; the Jewelers building, Broadway and Maiden Lane, are among the contracts executed by this firm. The company has traveled afield to do its work, and some years ago furnished and placed a complete installation for the locomotive and car construction works

NEW QUARTERS OF NEW YORK STEAM FITTING COMPANY AT 100 WASHINGTON STREET, NEW YORK

for the Mexican Central Railroad Co., at Aguas, Caliarties, Mexico. They also completed the municipal electric light plant for the city of Jacksonville, Fla., and a municipal water-supply plant in Oklahoma.

Among the recent work of this company is the complete mechanical equipment for the new New York Custom House, comprising the heating, ventilating, plumbing and electric work, being one of the largest single contracts for mechanical equipment ever awarded by the Government in New York City.

During the past season the New York Steam Fitting Company has completed the heating and ventilating equipment for

MAIN OFFICE, NEW YORK STEAM FITTING COMPANY

MACHINE SHOP IN NEW QUARTERS OF NEW YORK STEAM FITTING COMPANY

the Lawyers Title Insurance & Trust Co. building, 160 Broadway, and for the Gainsborough Studios, Fifty-ninth street and Central Park.

For many years this company and its predecessor were located at 137 Elm street, subsequently changed to Lafayette street, but, believing that its interests demanded that it should possess a home of its own, arrangements were consummated during the spring of 1908 for the erection of a building for its sole purposes. The firm is now located at 100 Washington street, where it has a fully equipped shop and ample storage capacity that will meet its requirements for some years to come.

NEW DEVICES

Air Washing and the Peerless Air Washer

The deleterious effects of dust and the influence of humidity upon human comfort and health are now clearly recognized. This recognition has led to ever increasing interest in the development of a successful apparatus for the cleansing and purification of air. Investigation has shown the dust particle to be the center of congregation for the micro-organisms as well as for the moisture with which the atmosphere is sometimes laden. If the dust particle is caught and removed we may therefore be sure that the accompanying bacteria have gone with it.

Reasoning along these lines, the elements of a successful air purifier have been defined by The New York Blower Company, of Chicago, in their new catalogue, descriptive of the Peerless Air Washer, in which they are embodied. From this publication the following extract is taken:

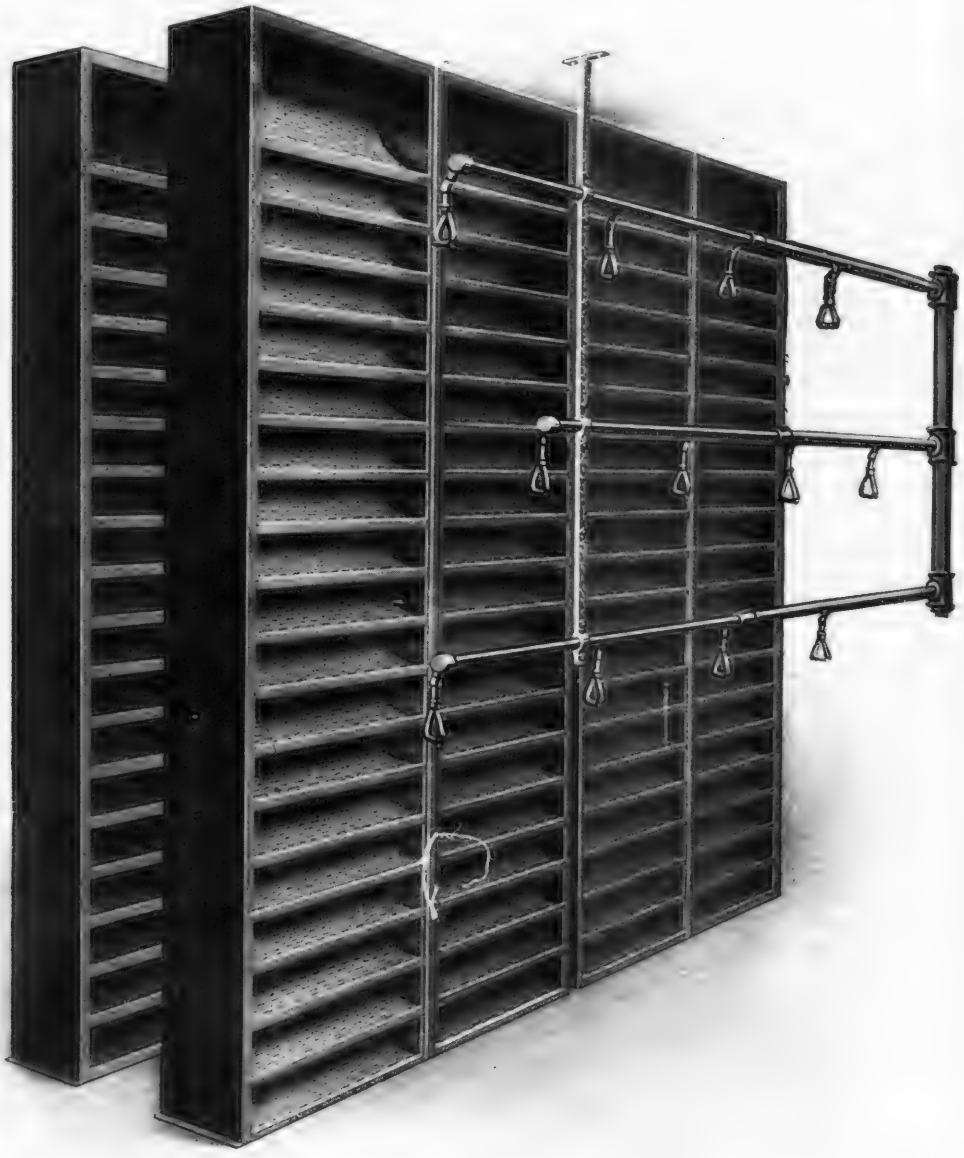
"Nature's own method of removal is to collect moisture on the mote of dust until, combined with others, it forms a drop of sufficient size to fall to the earth because of its weight. Millions of drops make the shower, sweeping clear the atmosphere of multi-millions of particles, absorbing gases and creating that wonderful clearness which is a sure sign of the resulting purity. No 'dry process' is used by nature and no artificial process can fully succeed in which dependence is placed upon screens of any type to merely hold the dust in dry form. They cannot be automatically cleaned and they always require periodic attention—if neglected they become worse than useless—a positive menace to health.

The real cleaning of the atmosphere is attained by the original attraction of the moisture by the dust particles. The washing effect of the descending drops is only an incident in the process. The cloud particles permeate the space in which they are, the raindrops are relatively few and far between. Any apparatus which undertakes to remove the dust by passing the air through sheets of water or artificial rain is doomed to inefficiency because Nature's fundamental principle is overlooked. An atmosphere permeated with mist—water in its most minutely divided form—must be presented to the dust laden air. Each dust particle then becomes the center of attraction for the vapor particles, it is increased in size and weight, the air becomes supersaturated with water held in mechanical suspension.

SPRAY HEAD OF THE PEERLESS AIR WASHER

This excess of moisture must be created in order to grasp and hold the solid matter. But once caught these particles may easily be separated from the air and conducted away with their burden of objectionable material. Hence the extractor or eliminator—a device designed to remove the mechanically suspended particles which represent the excess of moisture. In a word, supersaturation and extraction are the two essential elements in the cleansing and purification of air. The air leaving the extractor should retain no visible moisture; only

that which has been absorbed and with which it is saturated. The temperature within the spray chamber should be such that when the air is heated during its subsequent passage through the main heater or flue heaters the relative humidity will be sufficiently reduced.



THE PEERLESS AIR WASHER

An accessory of the air washer is the primary tempering coil which is absolutely necessary for use during the winter season. By its means, under thermostatic control, the air entering the spray chamber is warmed to just the temperature best adapted to the action of the spray. Without such provision for pre-heating of the air the entire apparatus would become inoperative when the temperature fell below freezing.

The material of an air washer, subject as it always is to constant contact with moisture, should be absolutely free from injury by it. All metal work should be

absolutely rustless. This requirement is best met by the use of brass and copper and to a lesser degree by galvanized iron.

ELIMINATOR PLATES OF THE PEERLESS AIR WASHER

No wood should enter into the construction, concrete should be substituted. Durability coupled with cleanliness should prevail."

The Marvel Thermostat

An interesting new temperature-regulating device, known as the Marvel Thermostat, has been placed on the market by the Queen City Electric Co., Elmira, N. Y. The device is the invention of the head of the company's experimental department, Mr. Guion. Among its advantageous features are mentioned the fact that it will not short-circuit and cannot corrode, as the contact points are made from strictly pure platinum, highly polished, and are closely adjusted by the company's experts, leaving no chance for dirt or dust to accumulate. The thermostat is regulated by turning a knurled knob at the bottom which is geared to the indicator. While the indicator is being moved to the desired point the mechanism on the inside of the thermostat case adjusts itself to the temperature indicated on the dial by means of a worm screw, which shifts the highly polished platinum points to their proper position.

The thermostat is so adjusted that a variation of one-half of one degree in the temperature in the room where it is located will make the contact which closes the motor circuit and starts the motor; this action automatically opens the draft door and closes the check door; in other words, turns "drafts on." The movement is reversed when the room gets warmer than the indicated temperature on the dial, as the expansion of the laminated bar in the thermostat causes a contact to be made on the opposite platinum point, which reverses the motor and moves the dampers back to the position of "drafts off."

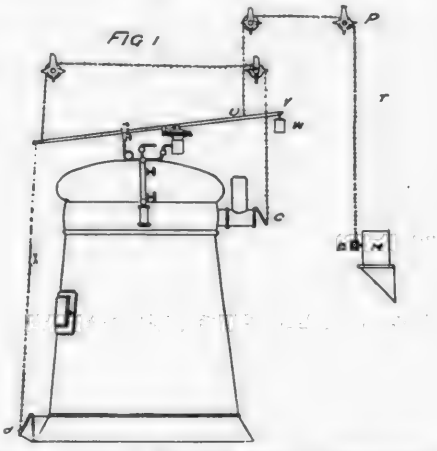


FIG 1—MARVEL THERMOSTAT ATTACHED TO A ROUND STEAM BOILER

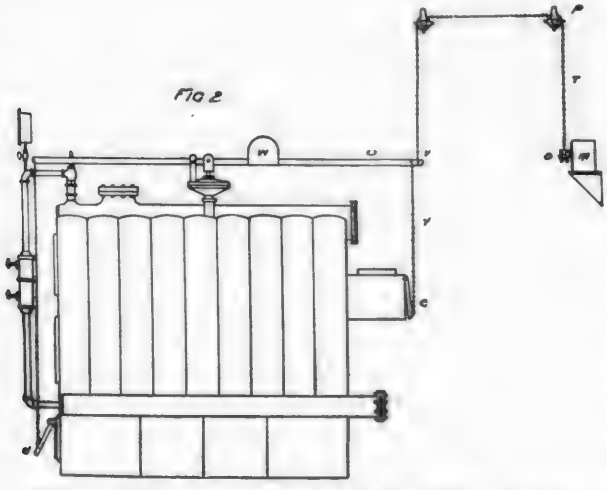


FIG 2—MARVEL THERMOSTAT ATTACHED TO A SECTIONAL STEAM BOILER

The motor is a departure from the spring type, which has prevailed for the past 27 years. It is an electric motor, and obviates one of the disagreeable features of a thermostat motor—the winding. The motor gets its power from dry batteries, and is geared so that it has a lifting capacity of over three times that of an ordinary spring motor.

Figs. 1 and 2 show methods of connecting the Marvel Thermostat to steam heaters in connection with draft-con-

trolling diaphragms. In Fig. 2 a chain runs from drum, D, over our frictionless pulleys, P, and attached to the end of the diaphragm lever, U, and continues down to the check draft, C, while at the other end of the lever a chain, X, runs from the draft door, d, to the diaphragm lever.

When the temperature in the room rises above the point at which the thermostat is set, the motor, M, will operate the drum, D, raising the diaphragm lever and opening the check draft, C, and at the same time closing the draft door, d. If the steam pressure should get too high before the rooms are warm enough to operate the thermostat, it will raise the diaphragm lever, U, and shut off the drafts. When the steam pressure goes down on account of the drafts being shut off, the thermostat will keep the drafts off until the temperature in the room begins to drop so as to operate the thermostat, which starts the motor in the opposite direction this time, turning the drafts on.

In a newly issued catalogue, describing the Marvel Thermostat, directions are given for connecting the device to hot-air furnaces and natural-gas furnaces as well as to steam and hot water heaters.

The thermostat is listed at $30.

Trade Literature

Modern Ventilating Apparatus, a new catalogue published by the Ilg Electric Ventilating Co., Chicago and New York, contains, among other things, the following "7 good points" of an electric ventilating fan:

FRAME.—Flanges are liberally proportioned, protecting fan wheel and making a pleasing and durable installation.

MOTOR RING.—Securely bolted to arms. Motor is machined circular to template, which makes it practical to install motor and frame separately without disturbing alignment.

OILING SYSTEM.—Both bearings uniformly oiled from one point, making it the only fan safely oiled while in operation.

SUPPORT ARMS.—Hand forged from machine steel, light, strong and non-breakable.

MOTOR ENCLOSURE.—Protects working parts of motor against dust, grease, steam or foreign matter, which eventually will damage motor.

WHEEL.—Steel spokes and blades stamped to template. Hub bored and reamed, making wheel perfectly true and running without vibration, insuring long life to bearings.

VENT PIPE.—Supplying motor with clean air, reducing working temperature, thus increasing its efficiency.

Types of the Ilg electric ventilating apparatus are illustrated, showing how the various requisites are included in the company's products.

The Movement of Vitiated Air

The greatest and most important constituent of air for attention is carbon dioxide, a gas resulting from the exhalation of human beings; and, although its existence in the atmosphere is essential for vegetable life, it is by no means an aid to animal existence.

It is a heavier gas than air, and does not support combustion; its chief effect appears to be the dilution of the oxygen in the air, or rather taking the place of the oxygen, rendering the air poorer; and, while there are other impurities, such as bodily waste and the like, which demand our more serious attention, still the presence of carbon dioxide is by no means an undesirable attribute to the air we breathe.

In this place we might mention the fact of the diffusion of gases, where two or more gases, irrespective of their differences in weight, without any artificial agitation, will ultimately mix, although at first they would seem to remain in separation. This is a most important point in the matter of heating and ventilation.

The gases given off from the body are usually at a temperature equal to that of the body and higher than that of the surrounding atmosphere. And under the influence of heat they are in a rarefied form, their buoyancy increasing with their bulk, yet their naturally excessive weight, owing to the presence of carbon dioxide, is more than compensated for by the influence of heat, causing them to rise on leaving the body. They seldom, however, rise above the head, owing to the cooling action of the adjacent vitiated air, and, although they rise more rapidly in a cool atmosphere, they cool more quickly, and begin to fall long before the temperature is reduced to that of the air.

In the case of the vitiation of air by combustion, although the chemical changes are similar to those resulting from the presence of human beings, there is a difference in behavior of the gases, owing to influence of heat. For instance, in a gas jet burning, which will consume five or six times the amount of oxygen as a human being, there is, as before, carbon dioxide and water vapor substituted for the oxygen, with the addition of carbon monoxide. Yet, though the chemical change is much the same, there is a large difference in the wastages in the two cases. Those emanating from the body are low in temperature compared with the products of combustion from the gas jet, and soon find their way to the floor, while the latter are heated to a high degree and rise rapidly, and, not being able to escape, remain near the ceiling until they at last cool and descend or diffuse.—F. B. CHALLONER, in *Domestic Engineering* (London).

TRADE AND MISCELLANEOUS NOTES

Coming Events

Meeting of Central Supply Association, Auditorium Hotel, Chicago, October 28, 1908.

Annual Meeting, American Society of Heating and Ventilating Engineers, New York, January 19, 20 and 21, 1909.

Deaths

George B. Little, vice-president of the Walworth Manufacturing Co., Boston, Mass., died at his home in Cohasset, September 26. He had been in ill health for some time. Mr. Little married a daughter of C. C. Walworth, and one of his sons is connected with the home office of the Walworth Manufacturing Co.

Gardner D. Hiscox, a well-known mechanical engineer, died at his home in East Orange, N. J., September 13. He was 65 years old. Mr. Hiscox was the author of several books on mechanical subjects, and was also a contributor to the technical papers on subjects of heating and ventilation. He is survived by a widow, three sons and one daughter.

Harry J. Ott, superintendent for the Illinois Engineering Co., Chicago, died in Denver, Colo., September 25, of typhoid pneumonia. Mr. Ott was a member of the Illinois Chapter of the American Society of Heating and Ventilating Engineers, and had been associated with the Illinois Engineering Co. for over six years. He was a frequent contributor to technical papers on heating and engineering topics. He leaves a widow.

William Holloway Bailey, for 58 years connected with the American Tube Works, of Boston, and for 50 years the company's New York representative, died at his home in New York, October 5. He was 75 years old. Mr. Bailey was a member of a number of engineering and other societies.

Miscellaneous Notes

Building operations for August, 1908, show a decrease in the eastern cities of 41%; Middle West, increase of 5%; southern cities, increase of 31%; Pacific Coast, decrease of 17%. The figures in New

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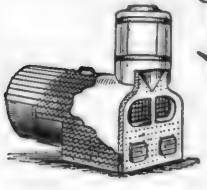

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HEAT AND COLD INSULATING MATERIALS

HEADQUARTERS FOR

85% MAGNESIA, ASBESTOS AND BRINE PIPE COVERINGS, ASBESTOS PRODUCTS, ETC.

ESTIMATES FURNISHED AND CONTRACTS EXECUTED.

100 NORTH MOORE ST, NEW YORK CITY.

York City dropped from $13,338,949 in 1907 to $6,966,630 in 1908. Chicago reported an increase.

Central Heating & Manufacturing Company, Little Rock, Ark., has been placed in the hands of a receiver, H. M. Armistead taking charge of the company's affairs. The company owes $99,000 on the plant, and it is estimated the plant itself is worth $200,000. The other debts amount to $12,000. The company will probably be reorganized. The Central Heating & Manufacturing Co. was organized in 1907 to take over the plant of the Little Rock Heating Co. The principals are George W. Caldwell, Charles T. Caldwell, Thomas V. Wilson, W. M. Kavanaugh and J. M. Spradling.

Ripon, Wis.—A central heating plant for Ripon has been proposed and a number of representative business men have already subscribed $20,000 of the $28,000 required for the construction of such a plant.

Albert Lea, Minn.—The city has extended its contract with the Albert Lea Light & Power Co. to supply heat to the city buildings for another five years.

Elwood Heat & Light Co., Elwood, Ind., was ordered sold by the court to satisfy claims amounting to $364,930. The plant is valued at $300,000, and consists of 71 miles of mains, 28 gas wells, real estate valued at $3,000 and a franchise to furnish heat and light in Elwood.

New Incorporations

Cape Charles Plumbing & Heating Co., Cape Charles, Va. Capital, $10,000. President and general manager, J. W. Jones; vice-president, L. E. Jackson; secretary and treasurer, W. B. Jones.

Pasadena Plumbing Co., Pasadena, Cal. Capital stock, $50,000. Incorporators: J. J. Hicks, C. Salmon, W. E. Allin, J. E. Youtz and Judge Merrill.

Aero Ventilator Mfg. Co., Rochester, N. Y. Capital, $30,000. Incorporators: J. Hicks Crippen, William D. Stewart and John D. Ripson, all of Rochester.

National Plumbing & Heating Supply Co., Chicago, Ill. Capital, $25,000. Incorporators: A. M. Eberhardt, J. M. Kahn and T. J. Lawless.

Colonial Fan & Motor Co., Warren, O. Capital, $10,000. Incorporators: J. B. Estabrook, E. E. Nash, Robert W. Bean, F. E. Watts and D. R. Estabrook.

Campbell Heating Co., Minneapolis, Minn. Capital, $25,000. Incorporators: Horace D. Campbell, Des Moines, Iowa; H. H. Van Bergen and Waldo Campbell, both of Minneapolis.

James A. Vogel Co., Wilmington, Del., heating and plumbing contractors. Capital, $25,000.

New Firms

Fairbury Heating & Plumbing Co., Fairbury, Ill., composed of W. B. Shaw and Walter Schwing, has opened a heating and plumbing establishment at that place.

W. W. Campbell & Son, 17 Wendell street, Boston, Mass., is a new firm in the heating and power piping business.

Carrier Air Conditioning Co., 39 Cortlandt street, New York, has been organized to take over the Buffalo Forge Company's rights in the air washers, humidifiers and humidity controlling apparatus manufactured under the Carrier patents. J. I. Lyle, formerly New York manager for the Buffalo Forge Co., is the general manager of the new company, and W. H. Carrier, the inventor of the system, is the company's consulting engineer.

Business Change

United Builders' Supply Co., Inc., San Francisco, Cal., has succeeded M. Levy & Co., and has moved into new quarters at 686-687 Mission street.

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And for Every Service. Write for Catalogue

The Mason Regulator Co.
Boston, Mass.

Business Chances

San Francisco, Cal.—A bond issue aggregating $3,514,520 has been consummated by the city through a syndicate of eastern capitalists. The money will be expended as follows: Fire protection system, $1,080,344; sewers, $868,075; new schools, $1,275,773, and hospitals, $295,328.

Beloit, Wis.—Heating plants, with separate boiler houses, will be installed in the Wright and Strong schools, the board of education having been authorized to negotiate a loan of $9,000 for the purpose.

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following named work:

Until October 30, 1908, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at Carthage, Mo.

Until Nov. 4, 1908, for the construction complete of the U. S. Post Office at Marietta, Ga.

Until Nov. 7, 1908, for the construction (including plumbing, gas piping, electric conduits and wiring) of the U. S. Post Office at Eugene, Ore.

Until Nov. 10, 1908, for the construction of the U. S. Post Office at Toledo, O.

Until November 16, 1908, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at Iola, Kan.

Until November 17, 1908, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at Crookston, Minn.

Until November 18, 1908, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at New Ulm, Minn.

Until November 19, 1908, for the construction (complete) of the U. S. Post Office at Rawlins, Wyo.

Until November 24, 1908, for the construction (complete) of the U. S. Post Office at Baker City, Ore.

Contracts Awarded

Thayer Supply Co., Atchison, Kan., steam heating the Pilkington, at that place.

Burnap Bros., Emporia, Kan., heating Chase County Court House.

S. A. Esswein Plumbing & Heating Co., Columbus, O., steam heating remodeled K. of P. Hall, in that city.

Charles Ross & Son, Sandusky, O., heating town hall at Huron.

Farwell & Co., Atchison, Kan., heating and plumbing Franklin school building, at their bid of $1,923.

John N. Murphy, Springfield, Ill., heating new Y. M. C. A. building in Springfield.

Hoffman & Conklin Co., Columbus, O., heating and plumbing new building for the Junior Order of United Mechanics at Tiffin; also heating and plumbing new Homœpathic Hospital at Pittsburg, Pa. The two contracts aggregate $35,000.

Jefferson City Steam Heating Co., Jefferson City, Mo., steam heating German Evangelical Central Church for $1,700.

Meister Bros., Fort Smith, Ark., heating new high school building at Van Buren.

H. G. Webbles, Mt. Vernon, Iowa, heating new gymnasium in that place, for $4,000.

American Heating Co., Superior, Wis., heating new Douglas County Asylum for $18,590.

Gunster Bros., Scranton, Pa., heating new West Pittsburg high school for $7,854.

Eddy Engineering Co., Alpeka, Mich., heating and plumbing new Avery school building for $1,460.

R. J. Mercer & Co., Traverse City, Mich., heating and plumbing new school building at Bellaire, O.

CLASS A RETURN TRAP

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The Albany Steam Trap Co.

ALBANY, N. Y.

Manufacturers of

RETURN STEAM TRAPS, NON-RETURN STEAM TRAPS, PUMPS, PUMP GOVERNORS. ALSO HIGH GRADE STEAM VALVES

Our 37 years' experience in this line is worthy of your attention

JAMES H. BLESSING
President

THOMAS F. RYAN
Sec. and Treas.

W. A. Bowers Heating Co., Milwaukee, Wis., central station hot water heating plant for 44 buildings for the National Home for Disabled Soldiers at Leavenworth, Kan.

P. Beatty, Beardstown, Ill., heating and plumbing new school building at that place for $3,884.

Reliable Heating & Plumbing Co., Champaign, Ill., contract for connecting new Y. M. C. A. building with the University heating plant.

Jas. Ballantyne Co., Ltd., Winnipeg, Manitoba, heating and ventilating Cecil Rhodes School at Winnipeg for $10,075.

Stevenson Bros., Schenectady, N. Y., steam heating and plumbing Robinson and Albany Street school in Schenectady for $16,000; also heating and plumbing Willett, Elmer and South Center Street schools, the latter amounting to $8,450; and heating and plumbing County Poor House at Middleburg.

Sanitary Plumbing Co., Beloit, Wis., vacuum steam heating Strong school building.

Martin & Wigman, Green Bay, Wis., central station heating plant at Sturgeon Bay, Wis.; also heating Brown County Court House for $6,880.

Fife Bros., Canton, O., steam heating Canton Post Office building for $3,549.

Justus Plumbing Co., Massillon, O., steam heating and plumbing new public school building at Sebring, O., for $3,200.

Carroll Bros., Lowell, Mass., heating New England Sanitarium at Spot Pond, Melrose.

Lewis & Kitchen, Kansas City, Mo., heating new Washington high school at Maryville, Mo., for $13,702; also steam heating and plumbing new public school building in Kansas City.

Kremer-Moon Heating Co., St. Louis, Mo., heating United States Post Office at St. Charles, Mo.; also steam heating Lafayette school, St. Clair County, Ill.

Wheeler-Blaney Co., Kalamazoo, Mich., heating and plumbing court house at Rhinelander, Wis.; also heating Woodward Avenue School in Kalamazoo for $14,000, heating and plumbing East Avenue School for $17,000, and addition to the Normal School in Kalamazoo for $10,000.

Pfau & Gilcoyne, Troy, N. Y., heating and plumbing hospital addition to St. Joseph's Home for $30,000.

Huey Bros., Boston, Mass., heating and ventilating new Rufus S. Frost Hospital at Chelsea for $5,377, and the National Shoe and Leather Bank building at Auburn for $3,000.

Hammer Bros., Great Barrington, Mass., steam heating Berkshire school at Sheffield and the Hallock school at Hamilton Grange.

B. McKenzie, Greensboro, N. C., steam heating Hotel Guilford in that city.

R. M. Masters, Charleston, S. C., heating and plumbing new Julian Mitchell school in Shepard street. Heating contract, $2,695; plumbing, $1,349.

John F. Johnson Co., New Bedford, Mass., heating new Registry of Deeds building in that city for $5,343.

THE MARVEL THERMOSTAT

THE ACME OF PERFECTION

It is made by men who have devoted the best part of their lives to the science of heat regulation, which accounts for the fact that we are now in position to offer you an Electric Thermostat which is entirely automatic (never has to be wound), and gives less than one degree variation in the temperature of the home, hotel, factory or, in fact, any building where a heating device of any kind is used.

IT WILL LAST A LIFETIME

Our Thermostat is not only correct in theory, but electrically and mechanically perfect. ¶ If you don't look into our product we are not the only loser. ¶ Our method of heat control is the latest in Electric Thermostats. ¶ "Just as good" means taking chances. Out-of-date methods do not satisfy up-to-date people. ¶ We will be glad to send our catalog on receipt of your request.

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We won't make a target of you with a follow-up system; we don't have to.
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CHICAGO - - NEW YORK - - BOSTON

E. E. Noble & Co., Princeton, Mass., heating county poor farm.

L. H. Prentice Co., Chicago, Ill., heating and ventilating new Royal Insurance Co. building in San Francisco, Cal., for $26,824.

E. E. Scott, Saginaw, Mich., steam heating new Auditorium building in Saginaw.

Boggess Bros., Atlantic, Iowa, heating and plumbing new school building at Lewis, Iowa.

Hurley & Co., St. Paul, Minn., heating new South Park school building in St. Paul for $3,550.

George A. Kees, St. Paul, Minn., steam heating new post office building at Los Angeles, Cal.

A. V. Rogoski, Little Rock, Ark., heating and plumbing Arkansas College, at Batesville; also two school buildings at Prescott.

Jerrard & Covington, Bemidji, Minn., heating St. Anthony's Hospital, at that place.

Ideal Heating & Construction Co., Davenport, Iowa, heating new Y. M. C. A. building in that city for $4,987.

Edward P. Bates, Syracuse, N. Y., heating and ventilating St. Joseph's Hospital, in Albany, for $9,000.

T. E. Logan, Sault Ste. Marie, Mich., heating and ventilating new school building at Newberry, Mich.

LeValley, McLeod & Co., Elmira, N. Y., heating and plumbing new post-office building at Ithaca.

Newman Plumbing Co., Evansville, Ind., heating and plumbing Manufacturers' Association building in Evansville for $12,540.

Wittman & Lyman, San Francisco, Cal., heating six-story building for Frank Maskey.

Mangrum & Otter, San Francisco, Cal., steam heating and ventilating Emma Rose building, in that city.

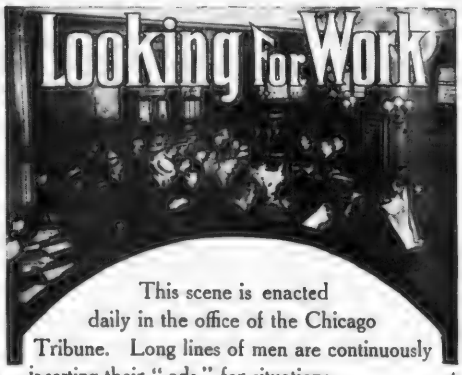
Hunt, Mirk & Co., San Francisco, Cal., boiler, pumps and piping for the Phelan building. The contract amounts to $22,668.

W. M. McCormick & Co., Sharon, Pa., steam heating and plumbing new $75,000 bank building in Sharon for G. V. Harmony, of Youngstown, O.

Philip Mulderick, Schenectady, N. Y., heating county jail building for $3,415.

Wicks, Hughes & Co., Utica, N. Y., hot water heating residence of Secretary of State Elihu Root, at Clinton; also heating and plumbing Utica Free Academy building.

Spencer Heating Co., Minneapolis, Minn., heating School of Forestry building at Botineau, N. D.



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How easily any one in this crowd could put himself forever above such a quest for insignificant, poorly paid positions!

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....STATIONARY ENGINEERING
....ARCHITECTURE
....HYDRAULICS
....COLLEGE PREP. COURSE

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Occupation.....

Pittsburgh Gage & Supply Co., Pittsburg, Pa., contract for building high-pressure steam lines for the Provident Coal Co., St. Clair, O.; W. B. Skelly Coal Co., Export, Pa.; Allegheny General Hospital and Monongahela Incline Co.

Salina Plumbing Co., Salina, Kan., heating and plumbing new Wesleyan Science Hall, in Salina.

Frank Gage, Fairbury, Neb., heating and plumbing new school building in that place.

Haws Hardware & Furniture Co., Minden, Neb., heating Exchange Bank building, at that place.

McMillan & Wagner, Moorhead, Minn., heating and plumbing First Ward school building, in that place.

Jonas A. Mills, Canton, O., heating and plumbing new central engine and police patrol building in Canton for $9,995.

Dewstoe & Brainerd Co., Cleveland, O., heating and plumbing Sterling & Welch Co.'s large store building, in that city.

Fitzpatrick & Hoefpner, Columbus, O., heating Stark County Court House, at Canton, for $4,670.

E. L. Dimmick, Laurel, Neb., heating and plumbing new school building at Wayne, Neb.

H. Kelly & Co., Minneapolis, Minn., heating new schoolhouse at Hopkins, Minn.

Kelley & Bell Co., Aberdeen, S. D., hot water heating Beard block, at that place.

Graeber Bros., Lawrence, Kan., heating and plumbing new Mining Engineers building, at that place.

George H. McClean, Springfield, Mass., heating Hampden Street block, in that city.

O'Toole Bros., Clinton, Mass., ventilating State Industrial buildings at Lancaster.

N. H. Lee, Northampton, Mass., heating new buildings for the Smith Agricultural School.

John W. Danforth Co., Buffalo, N. Y., contract for conduit and piping for Hudson River State Hospital, amounting to $13,447; also installing conduit and piping at Middletown State Hospital for $18,790.

John Dyer, Jr., Albany, N. Y., installing conduit and piping in Acute Hospital building, Middletown State Hospital, for $6,470.

Griscom-Spencer Co., New York, boilers, heater and steam piping in Long Island State Hospital building. The contracts amounts to $7,500.

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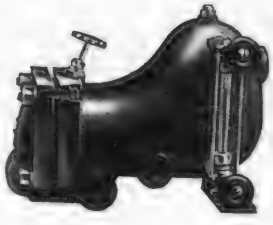

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P. F. Maginn, Pittsburg, Pa., steam heating new $80,000 residence for James W. Friend.

Kittleberger Bros., Clearfield, Pa., steam heating and plumbing new Third Ward public school for $4,000.

Egan Plumbing & Heating Co., East Pittsburg, Pa., heating and plumbing new St. Coleman's parochial school building, at Turtle Creek, Pa.; also heating and plumbing new German Turn Verein Hall, at Homestead.

Hawkins Bros. Co., Painsville, O., steam heating, ventilating and plumbing contracts for the new Central High School building, in Painsville.

William Hare's Sons, Wheeling, W. Va., steam heating and plumbing new $100,000 Y. M. C. A. building in Wheeling.

Cragin, Wilkins Co., Leominster, Mass., steam heating new library building at Leominster.

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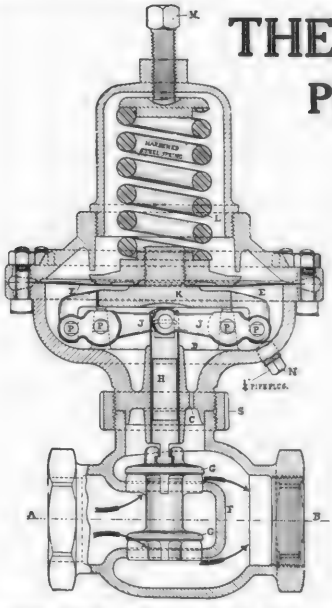

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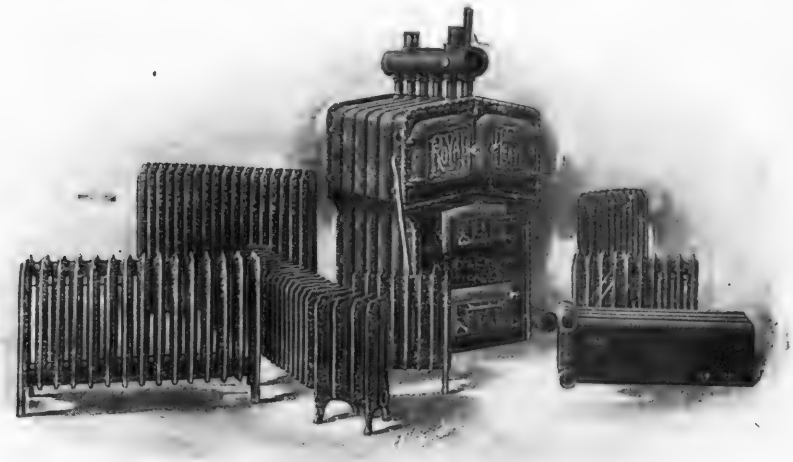

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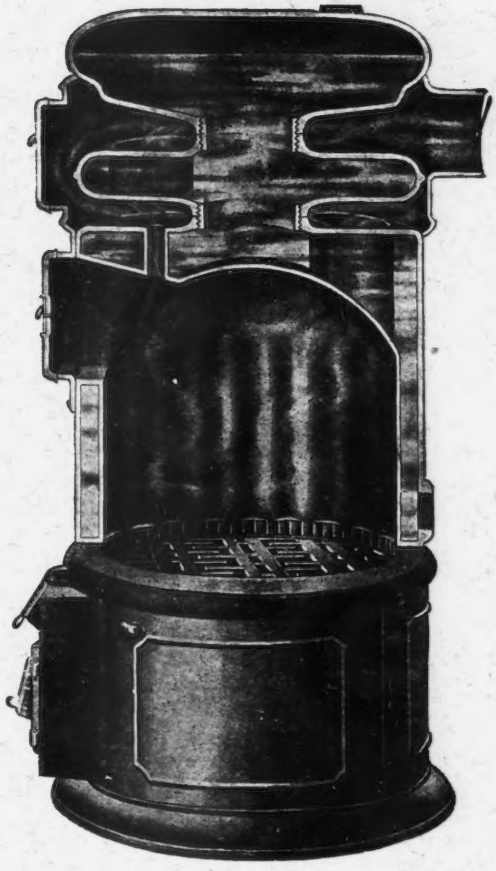

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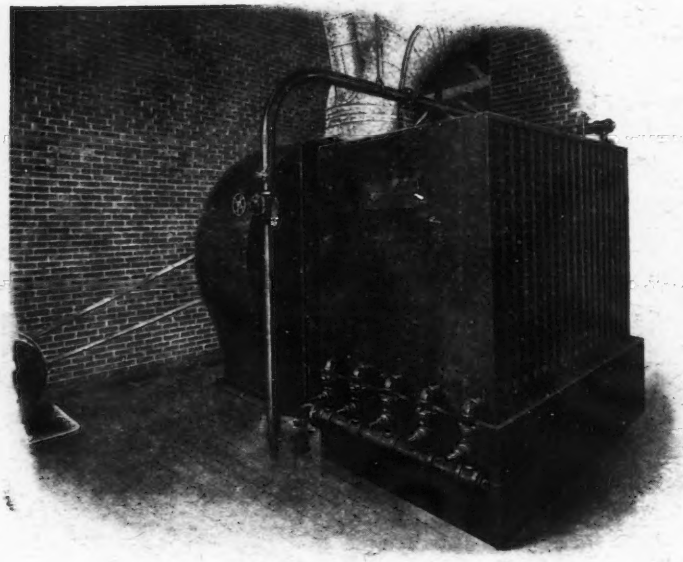

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